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Murata et al.

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(54) **SHEET PROCESSING APPARATUS**

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(51) **Int. Cl.**
B26F 1/24 (2006.01)
B26D 7/06 (2006.01)

(52) **U.S. Cl.** **83/13**; 83/30; 83/618; 83/446

(58) **Field of Classification Search** 83/30, 83/357, 368, 618, 628, 571, 572, 692, 690, 83/446, 448, 13
See application file for complete search history.

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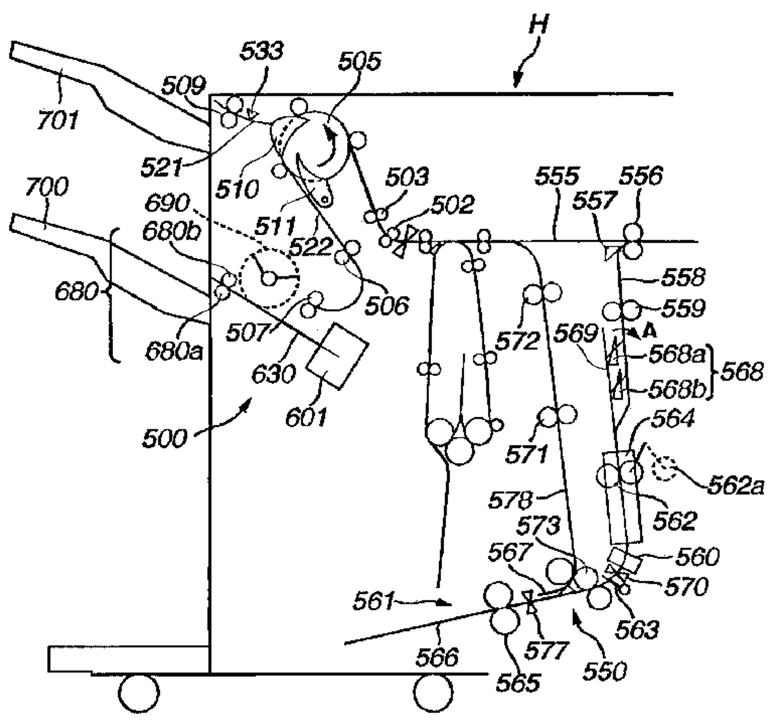
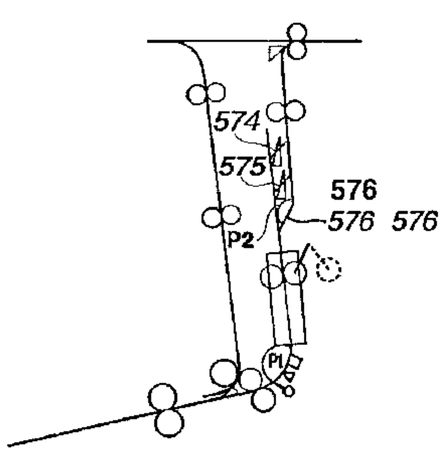
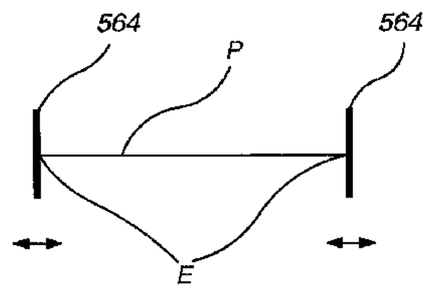
(57) **ABSTRACT**

When performing a punching operation for each of sheets individually conveyed to a predetermined punching position within a conveying path, each of the individually conveyed sheets is positioned at the predetermined punching position before performing the punching operation.

12 Claims, 15 Drawing Sheets







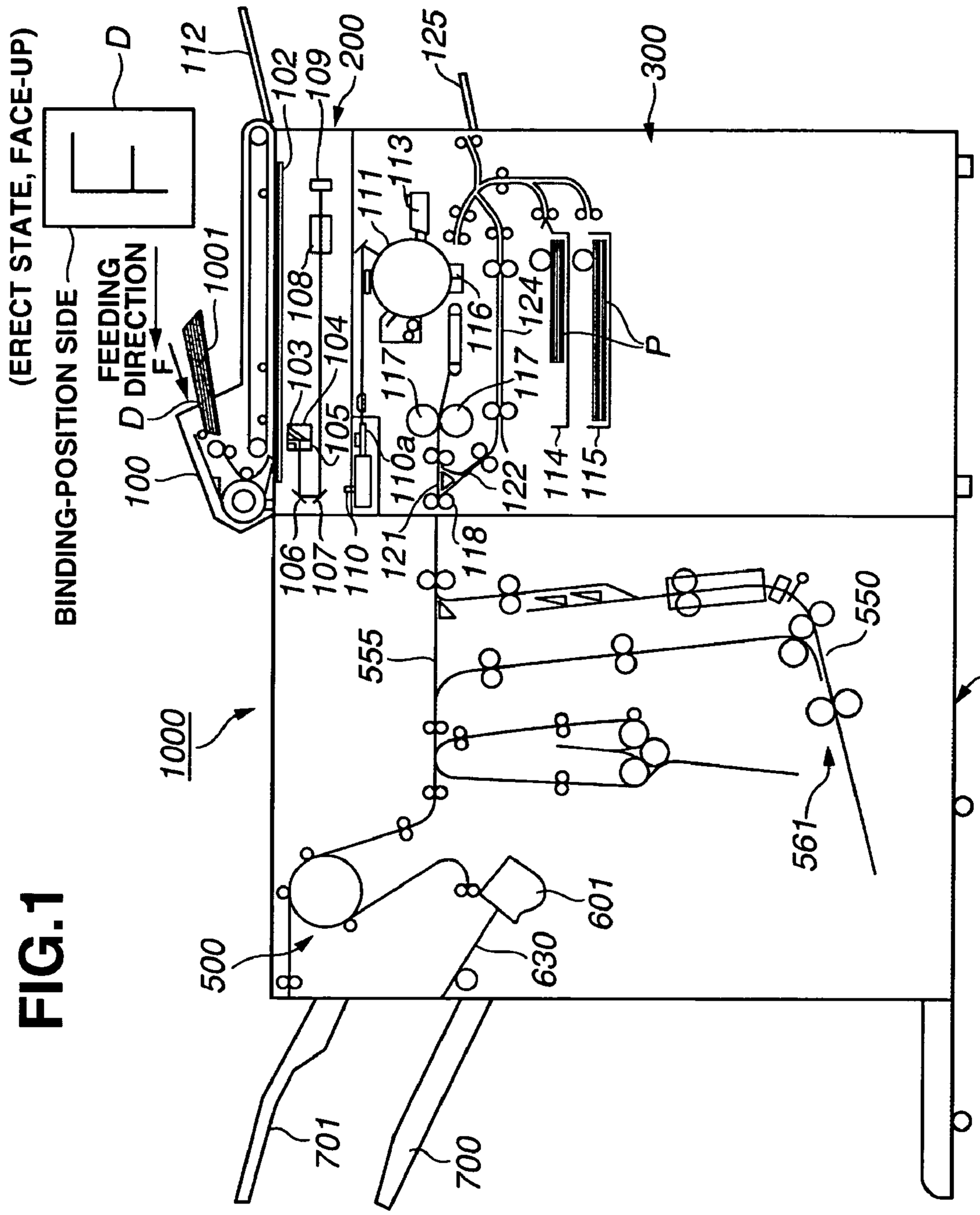

(ERECT STATE, FACE-UP)
D
112
102
109
200
125
300
BINDING-POSITION SIDE
FEEDING DIRECTION
D
F
1001
100
103
108
104
105
111
113
117
110a
116
124
117
P
106
107
110
121
118
122
114
115
555
550
561
1000
601
500
630
H
701
700

FIG. 1

FIG.2A

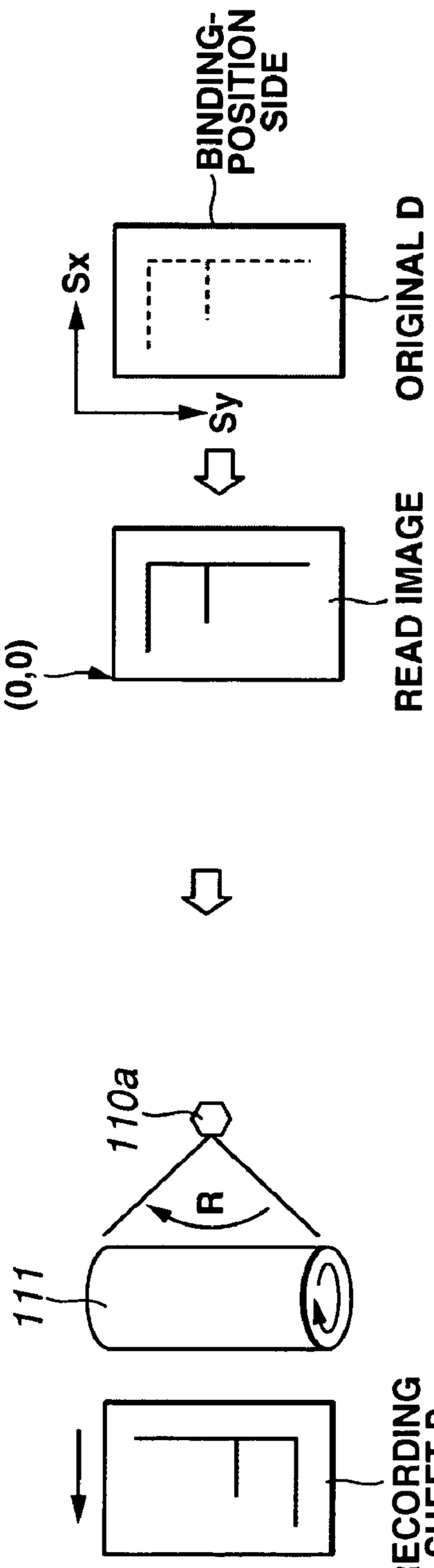

BINDING-POSITION SIDE
ORIGINAL D
Sx
Sy
READ IMAGE
(0,0)
110a
R
111
RECORDING SHEET P

FIG.2B

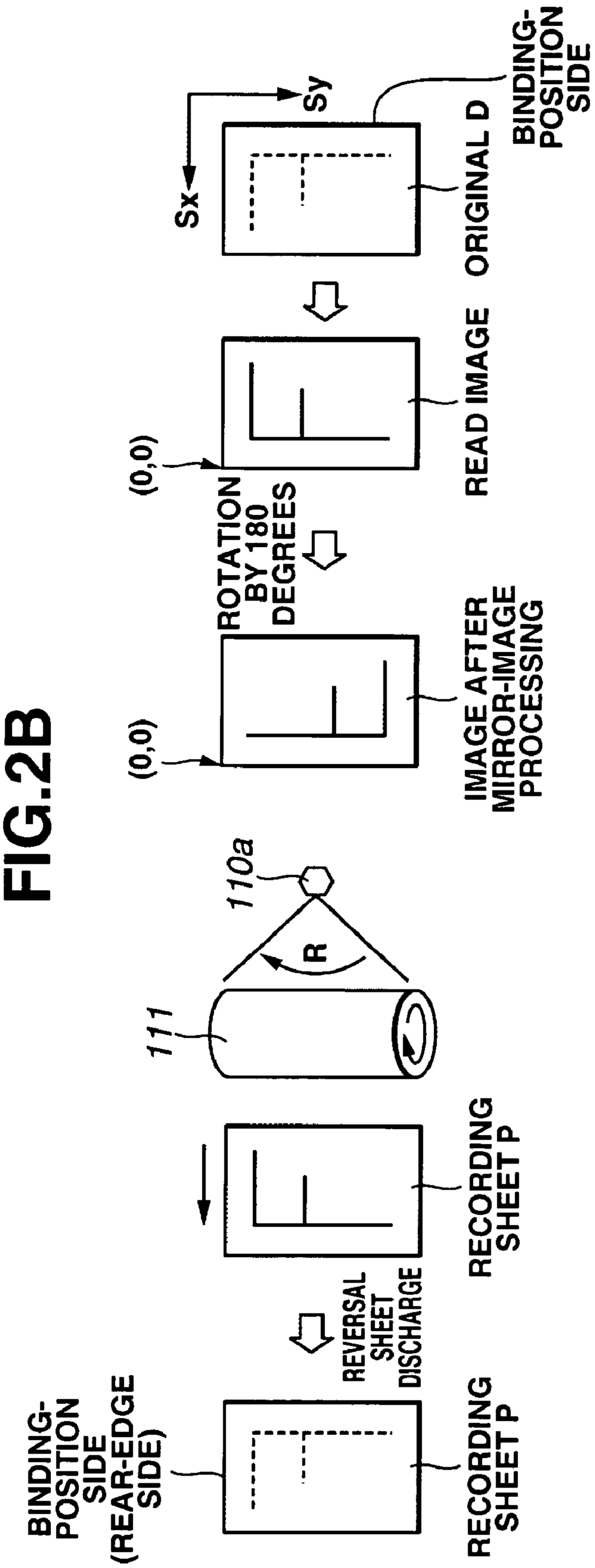

BINDING-POSITION SIDE
ORIGINAL D
Sx
Sy
READ IMAGE
(0,0)
ROTATION BY 180 DEGREES
IMAGE AFTER MIRROR-IMAGE PROCESSING
110a
R
111
REVERSAL SHEET DISCHARGE
RECORDING SHEET P
BINDING-POSITION SIDE (REAR-EDGE SIDE)

FIG.3

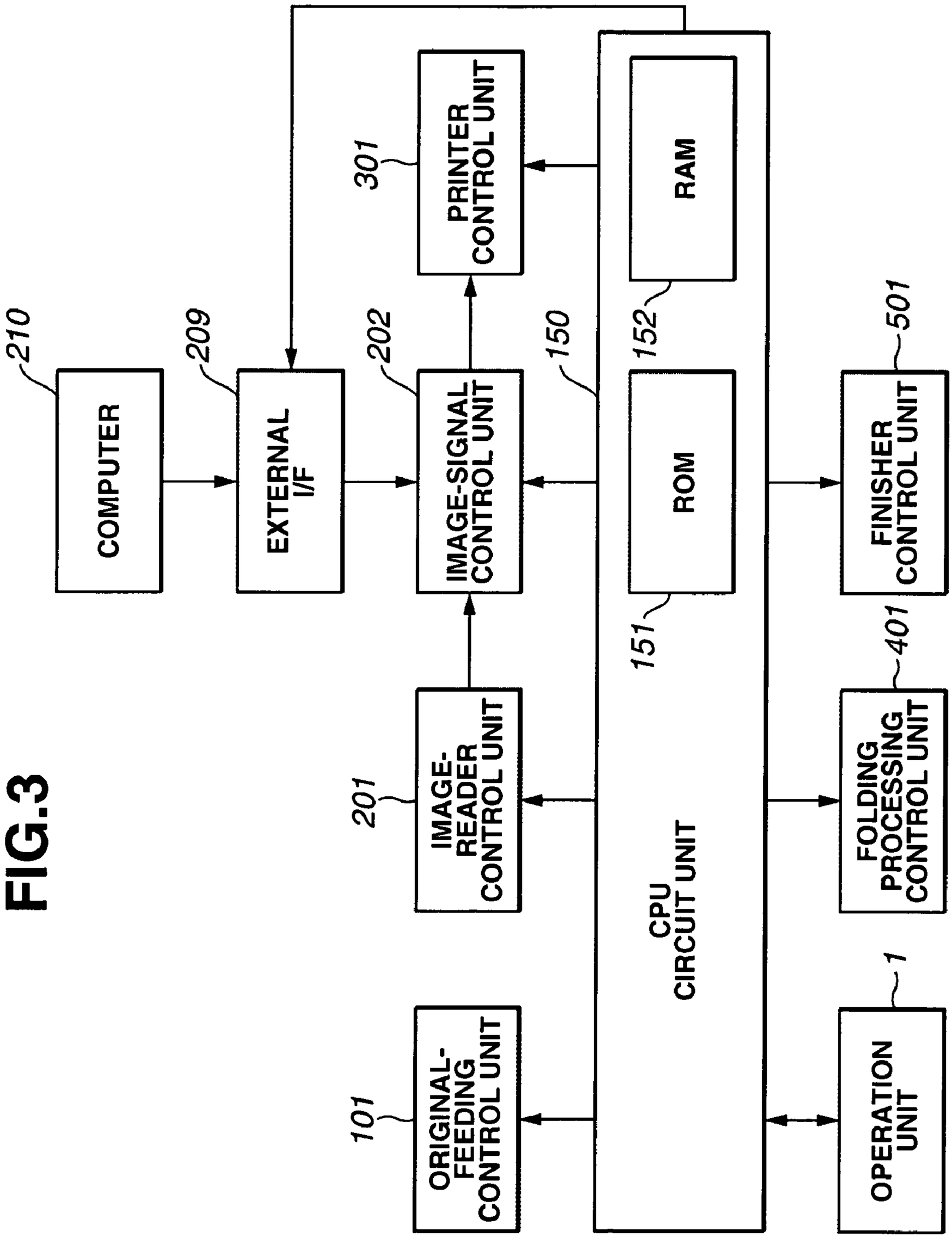

210
COMPUTER
209
EXTERNAL I/F
202
IMAGE-SIGNAL CONTROL UNIT
301
PRINTER CONTROL UNIT
150
RAM
152
ROM
151
201
IMAGE-READER CONTROL UNIT
CPU CIRCUIT UNIT
501
FINISHER CONTROL UNIT
401
FOLDING PROCESSING CONTROL UNIT
101
ORIGINAL-FEEDING CONTROL UNIT
OPERATION UNIT

FIG.4

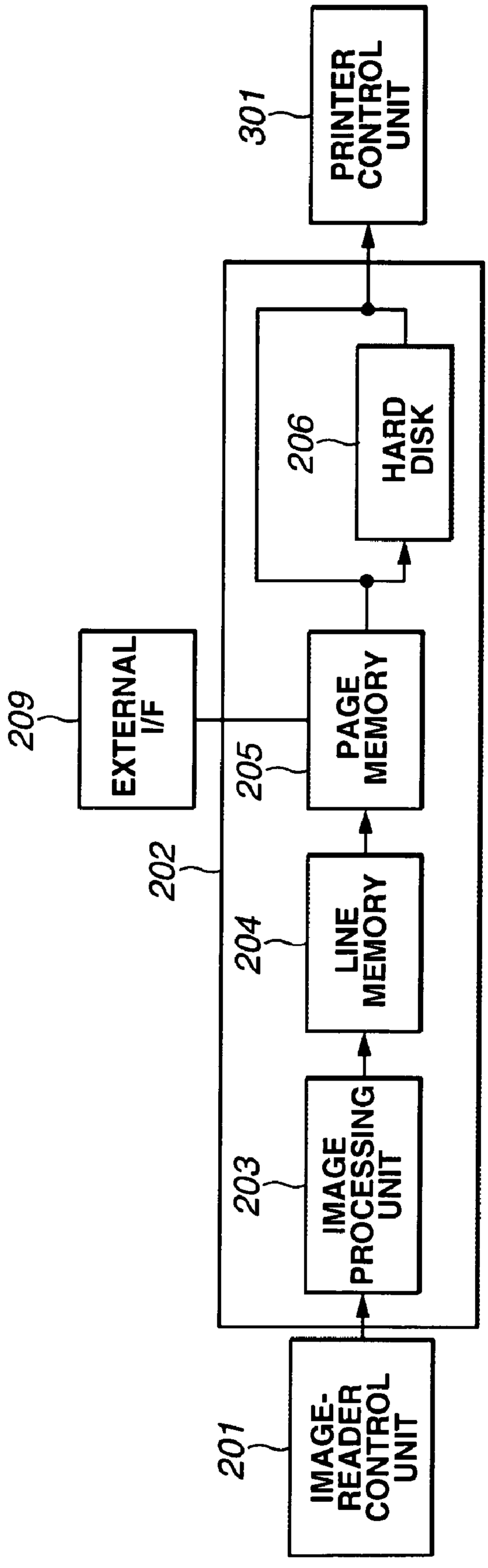

301
PRINTER CONTROL UNIT
206
HARD DISK
209
EXTERNAL I/F
205
PAGE MEMORY
202
204
LINE MEMORY
203
IMAGE PROCESSING UNIT
201
IMAGE-READER CONTROL UNIT

FIG.5A

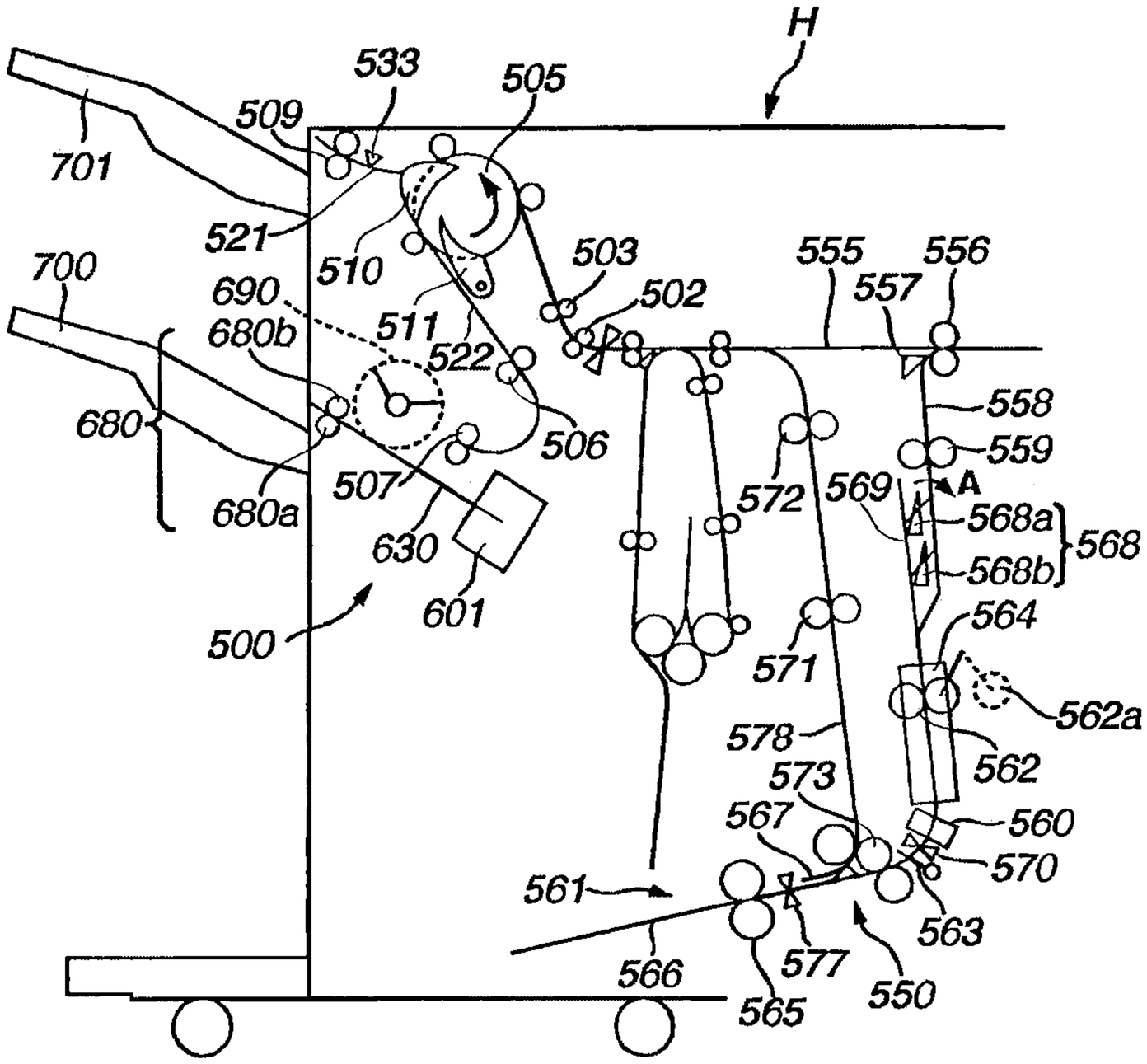


FIG.5B

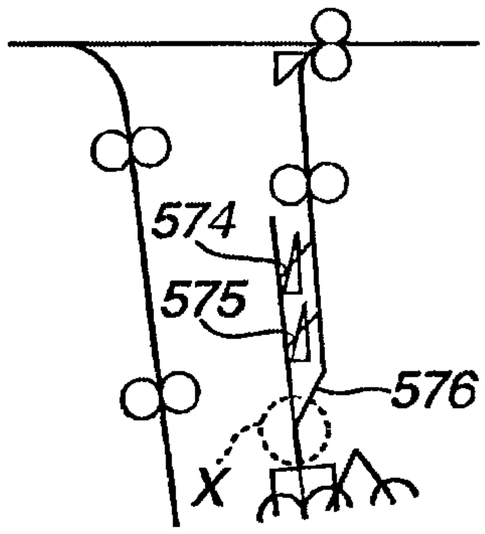


FIG.5C

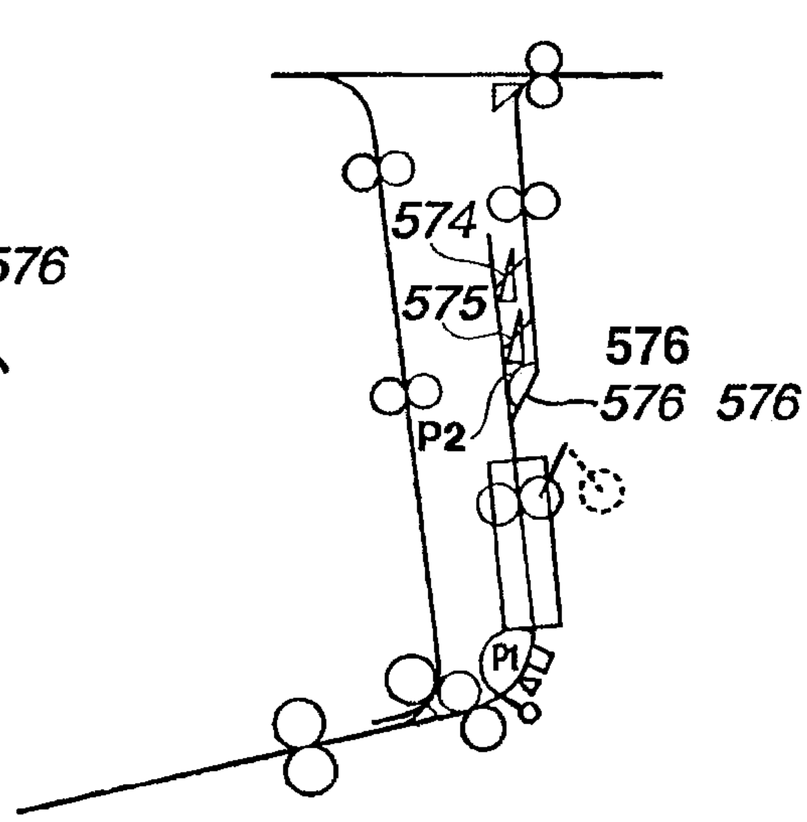


FIG.5D

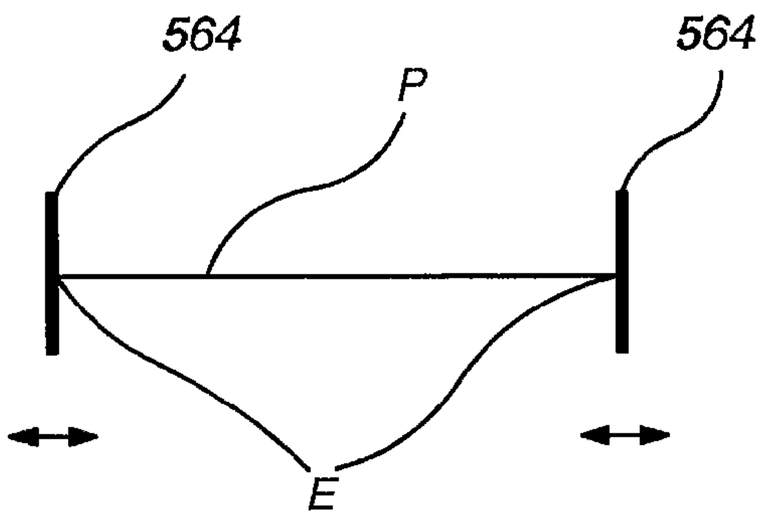


FIG.6

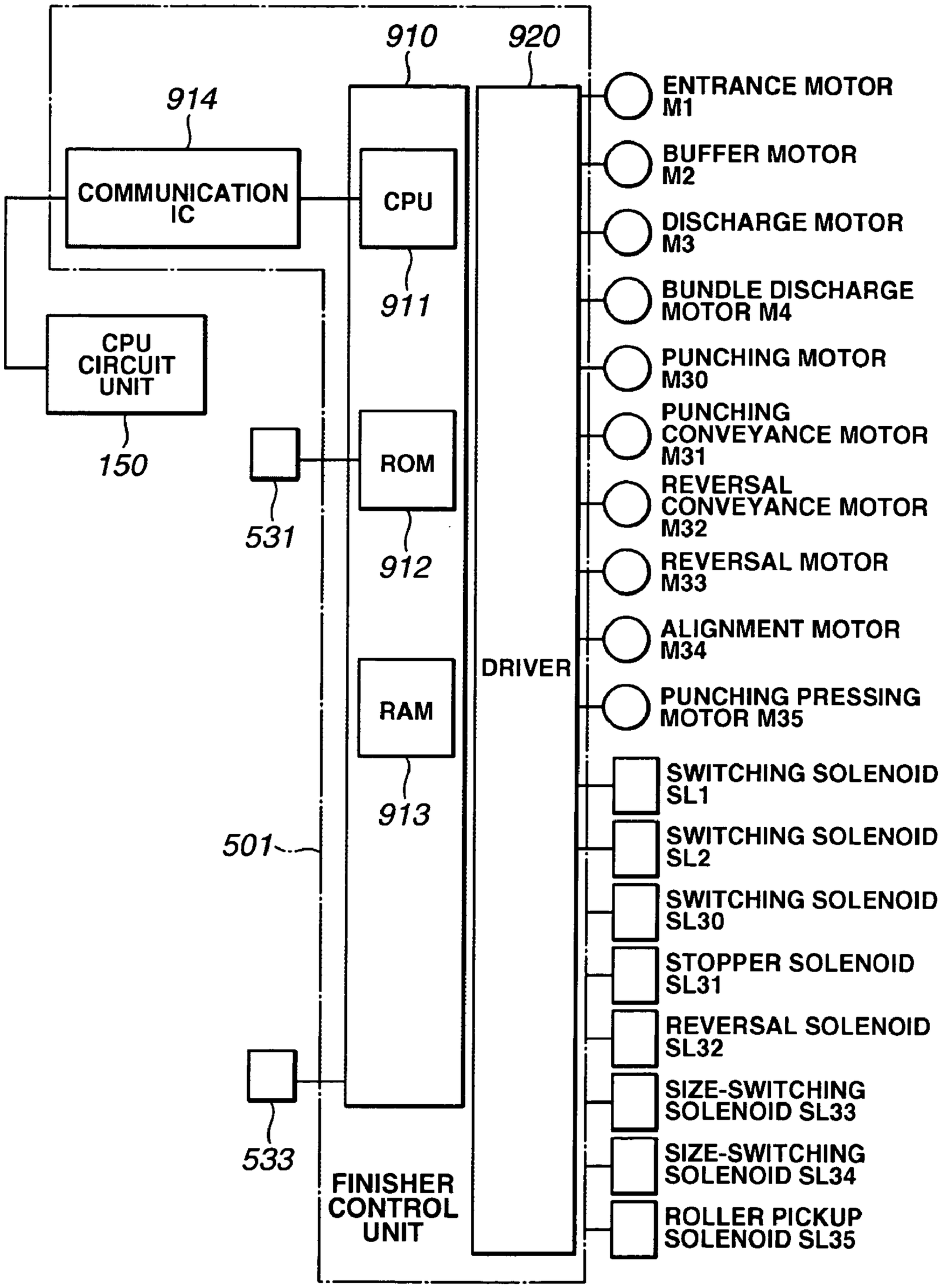

910
920
914
COMMUNICATION IC
CPU
911
CPU CIRCUIT UNIT
150
531
ROM
912
RAM
913
501
533
DRIVER
FINISHER CONTROL UNIT
ENTRANCE MOTOR M1
BUFFER MOTOR M2
DISCHARGE MOTOR M3
BUNDLE DISCHARGE MOTOR M4
PUNCHING MOTOR M30
PUNCHING CONVEYANCE MOTOR M31
REVERSAL CONVEYANCE MOTOR M32
REVERSAL MOTOR M33
ALIGNMENT MOTOR M34
PUNCHING PRESSING MOTOR M35
SWITCHING SOLENOID SL1
SWITCHING SOLENOID SL2
SWITCHING SOLENOID SL30
STOPPER SOLENOID SL31
REVERSAL SOLENOID SL32
SIZE-SWITCHING SOLENOID SL33
SIZE-SWITCHING SOLENOID SL34
ROLLER PICKUP SOLENOID SL35

FIG.7

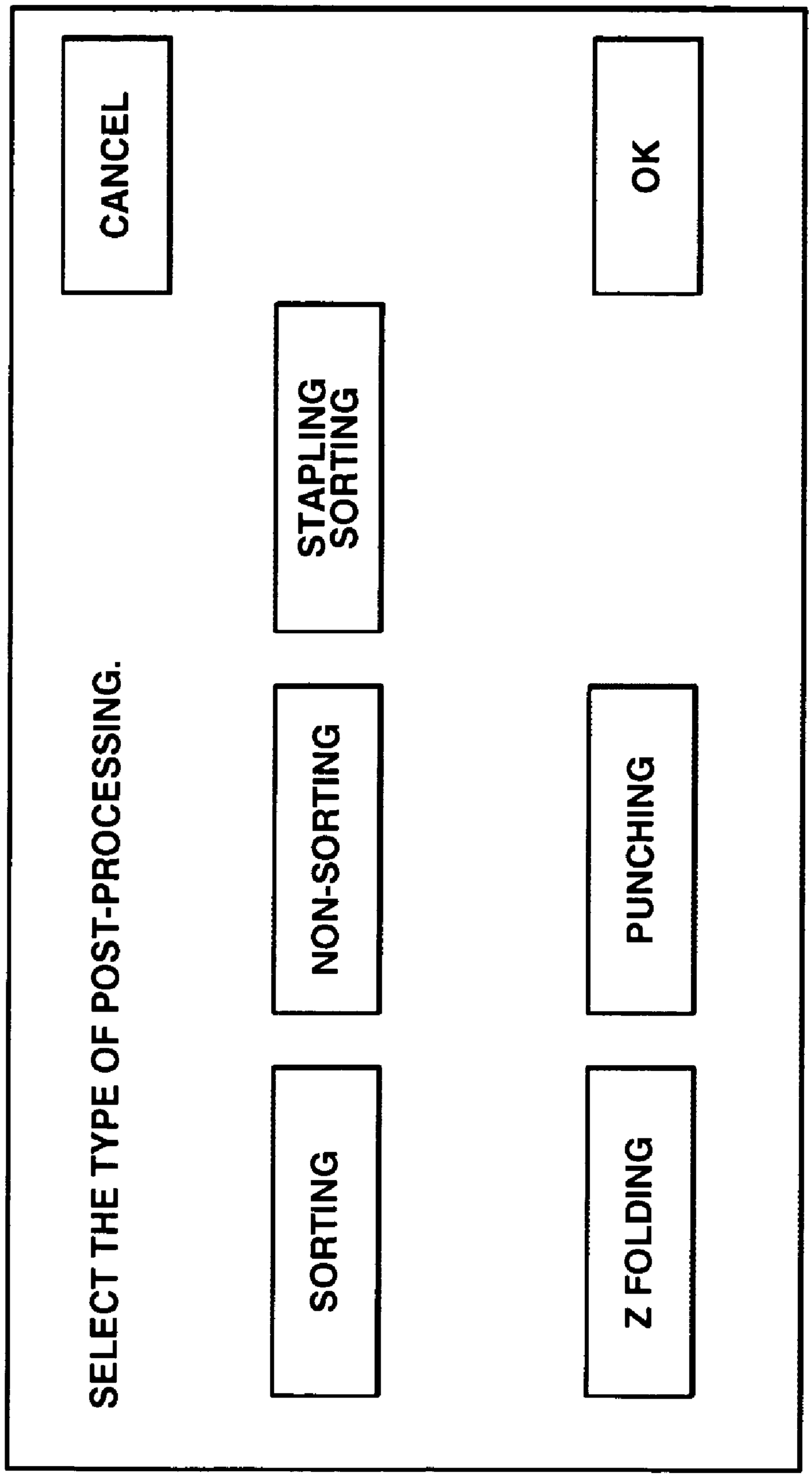

CANCEL
OK
SELECT THE TYPE OF POST-PROCESSING.
NON-SORTING
STAPLING SORTING
PUNCHING
SORTING
Z FOLDING

FIG.8

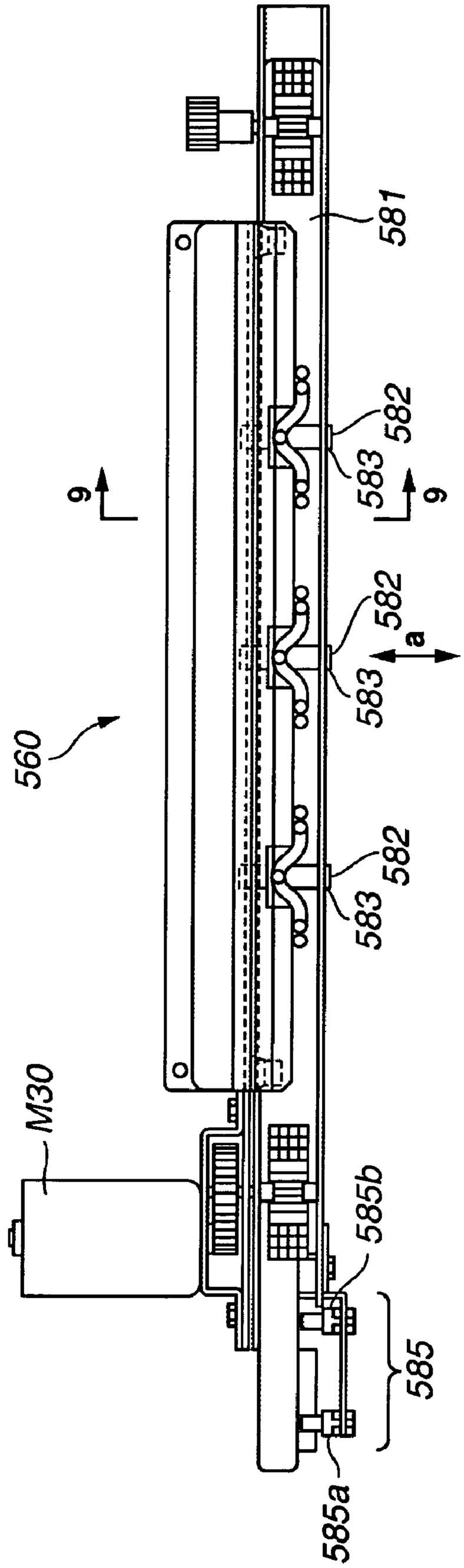


FIG.9

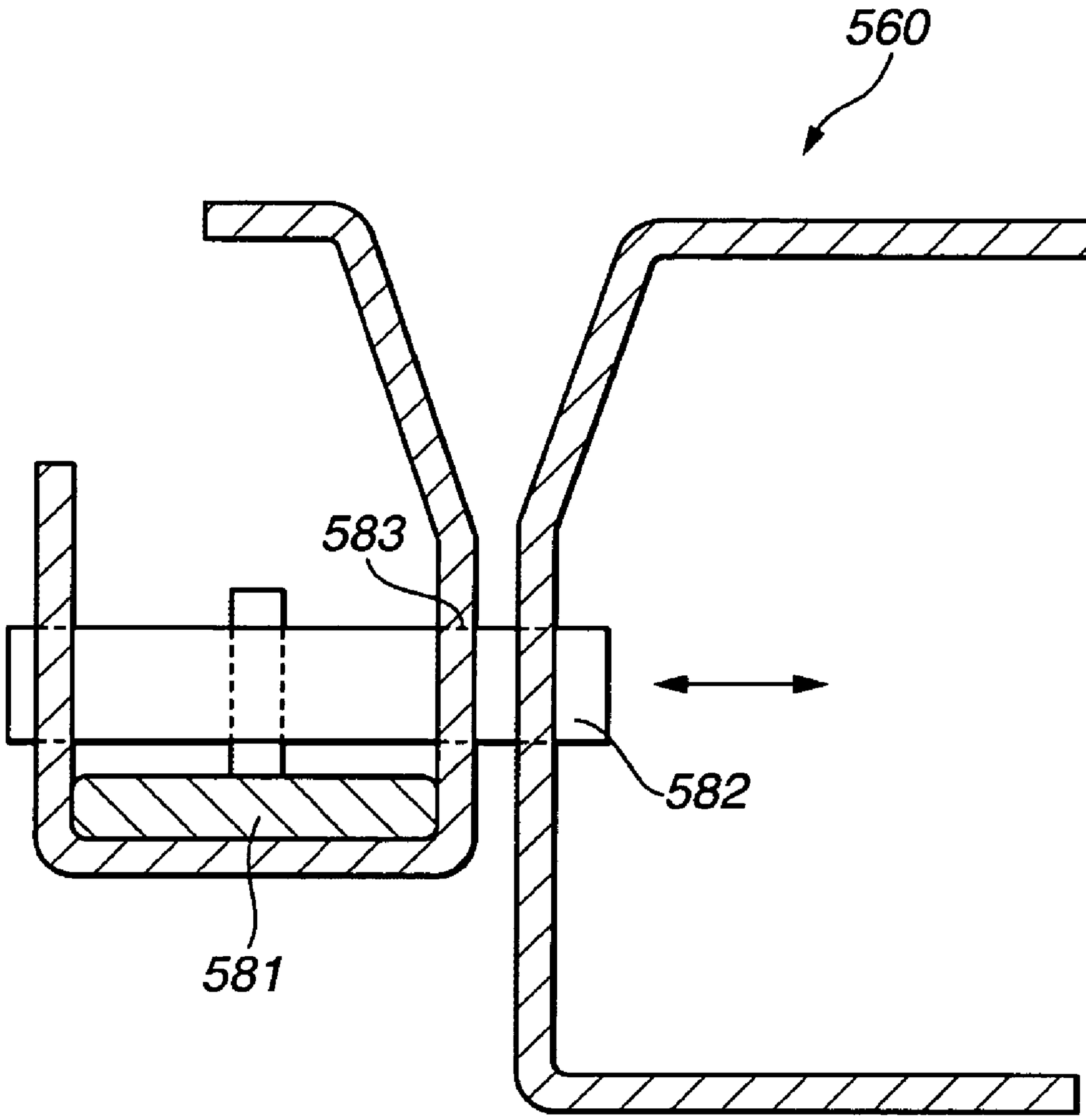


FIG.10

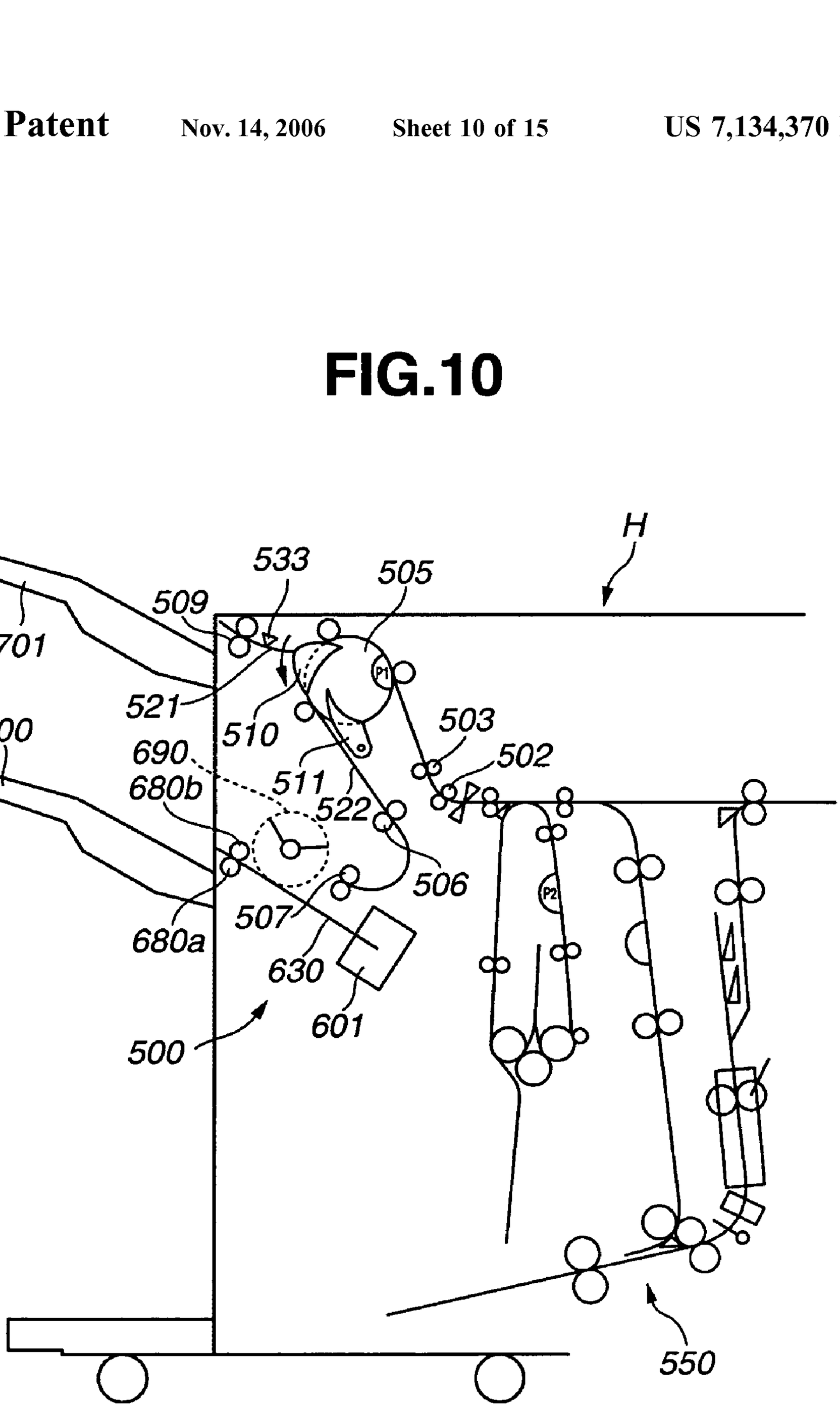

H
533
505
509
701
521
510
P1
503
700
690
502
680b
511
522
506
P2
507
680a
630
601
500
550

FIG.11

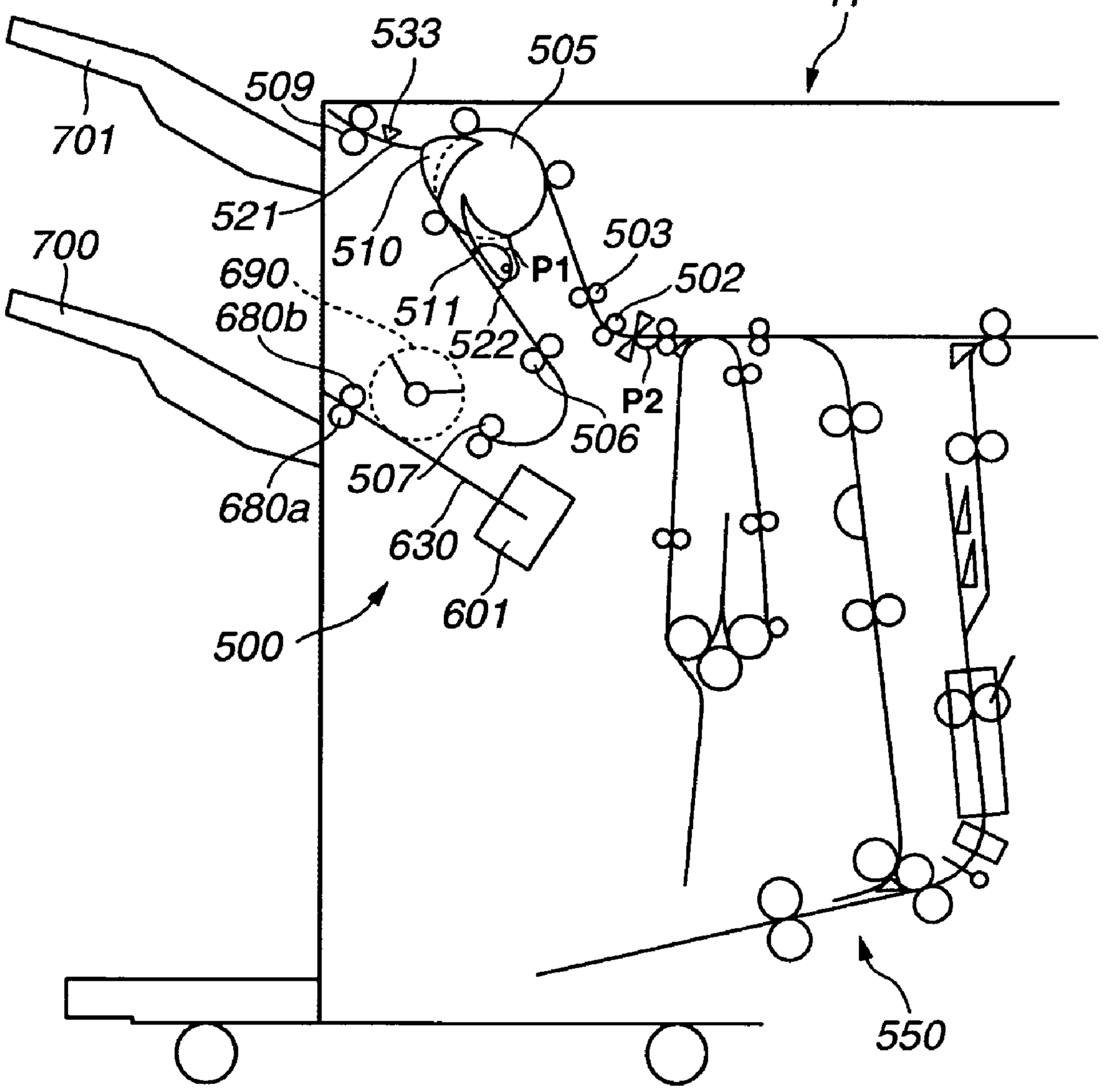

H
533
505
509
701
521
510
503
700
690
P1
502
680b
511
522
P2
506
507
680a
630
601
500
550

FIG.12A

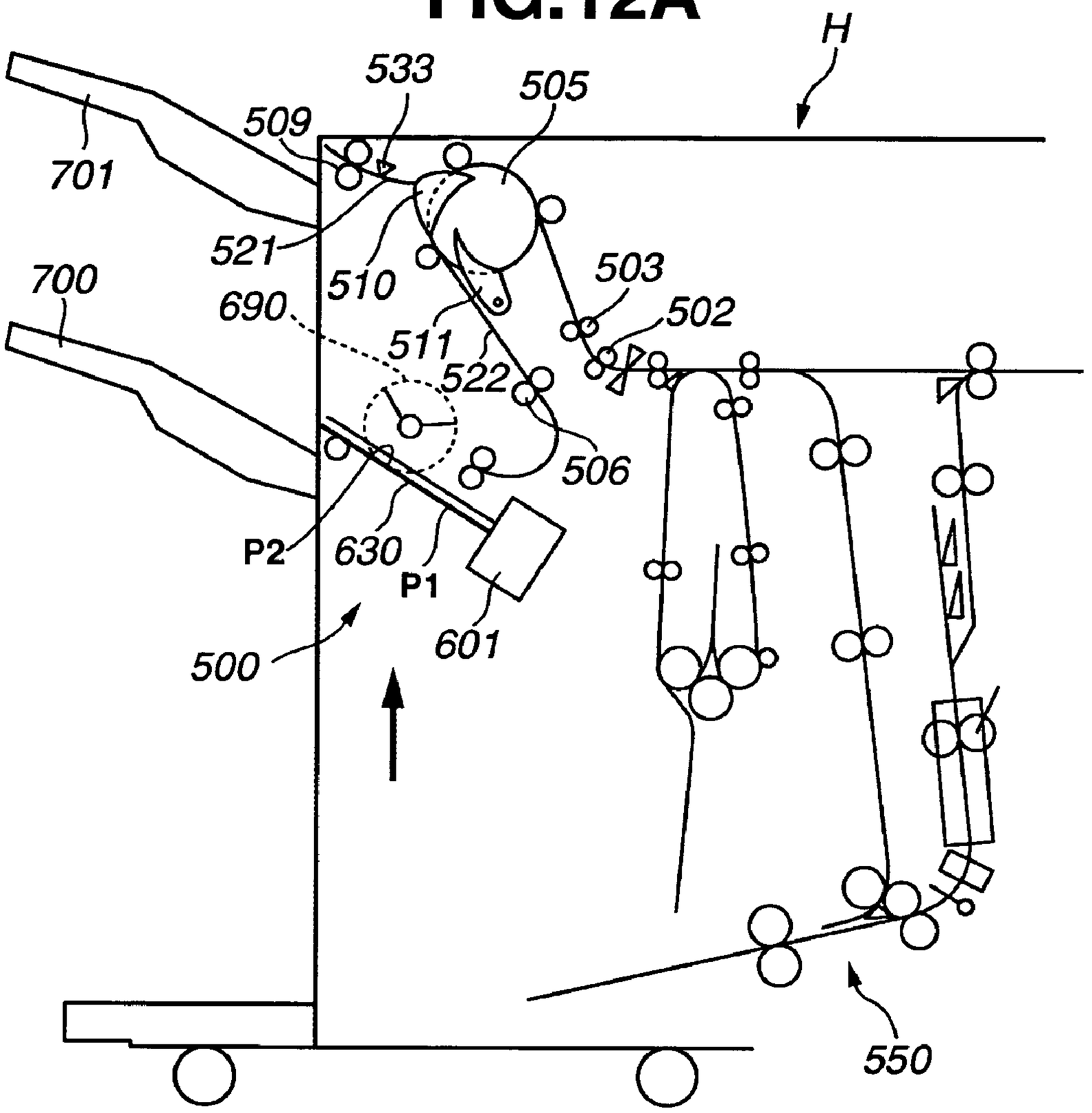


FIG.12B

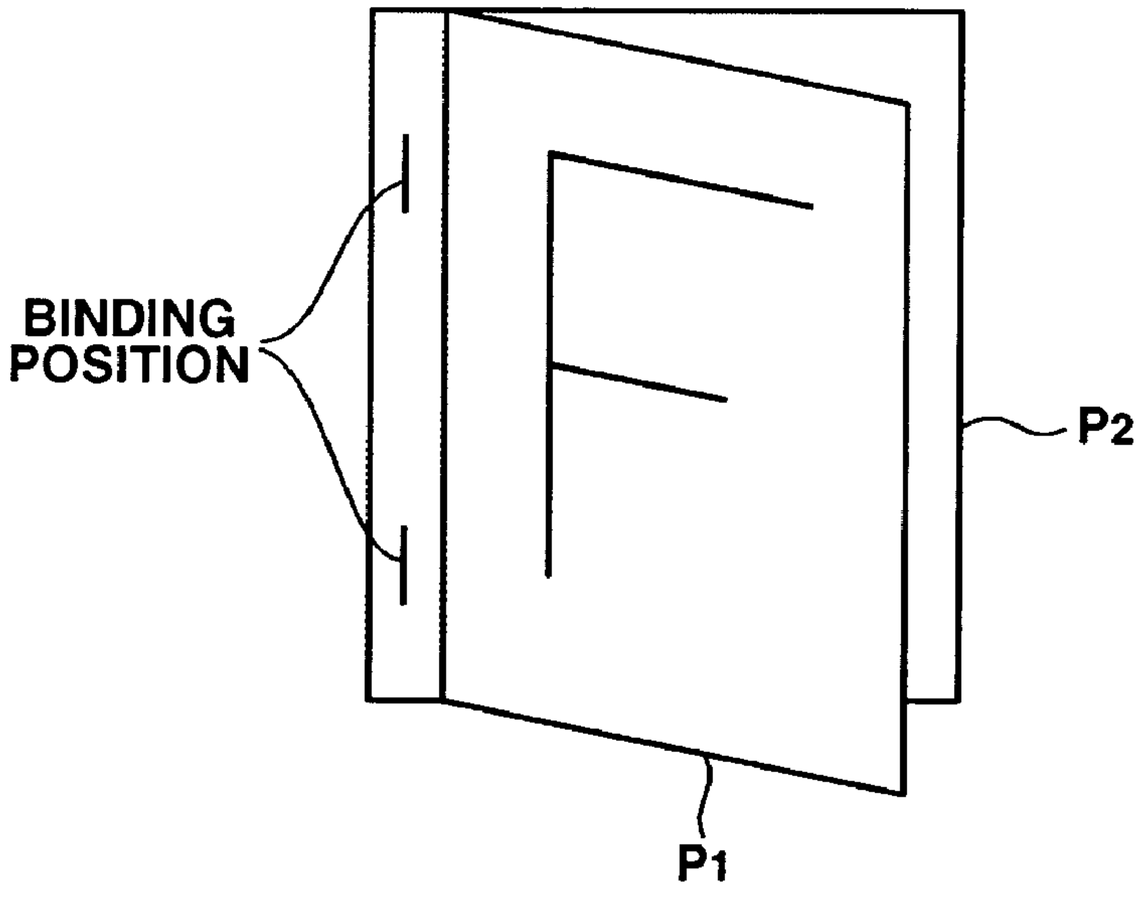


FIG.13

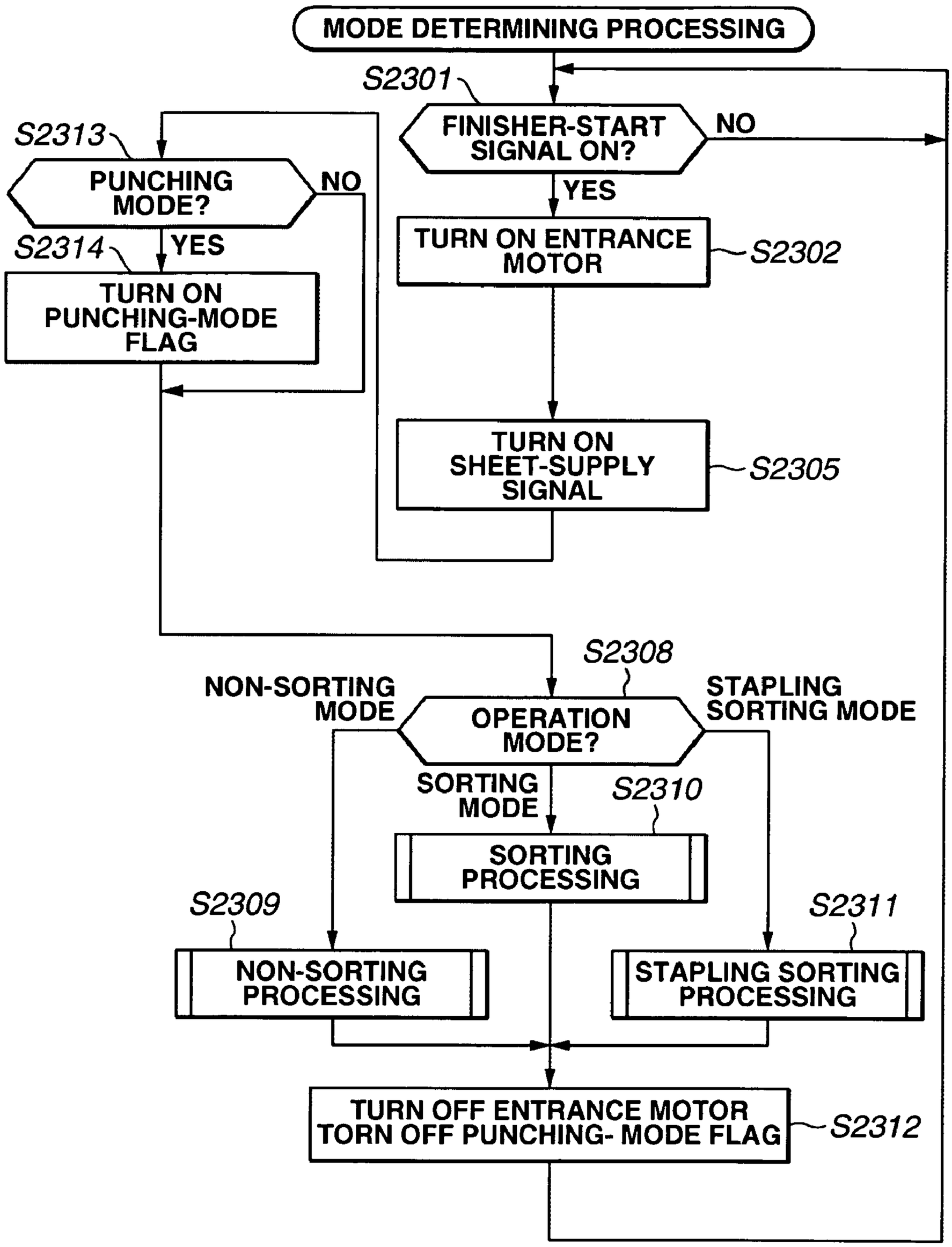

MODE DETERMINING PROCESSING
S2301
FINISHER-START SIGNAL ON?
NO
YES
TURN ON ENTRANCE MOTOR
S2302
TURN ON SHEET-SUPPLY SIGNAL
S2305
S2313
PUNCHING MODE?
NO
S2314
YES
TURN ON PUNCHING-MODE FLAG
S2308
NON-SORTING MODE
OPERATION MODE?
STAPLING SORTING MODE
SORTING MODE
S2310
SORTING PROCESSING
S2309
NON-SORTING PROCESSING
S2311
STAPLING SORTING PROCESSING
TURN OFF ENTRANCE MOTOR
TORN OFF PUNCHING- MODE FLAG
S2312

FIG.14

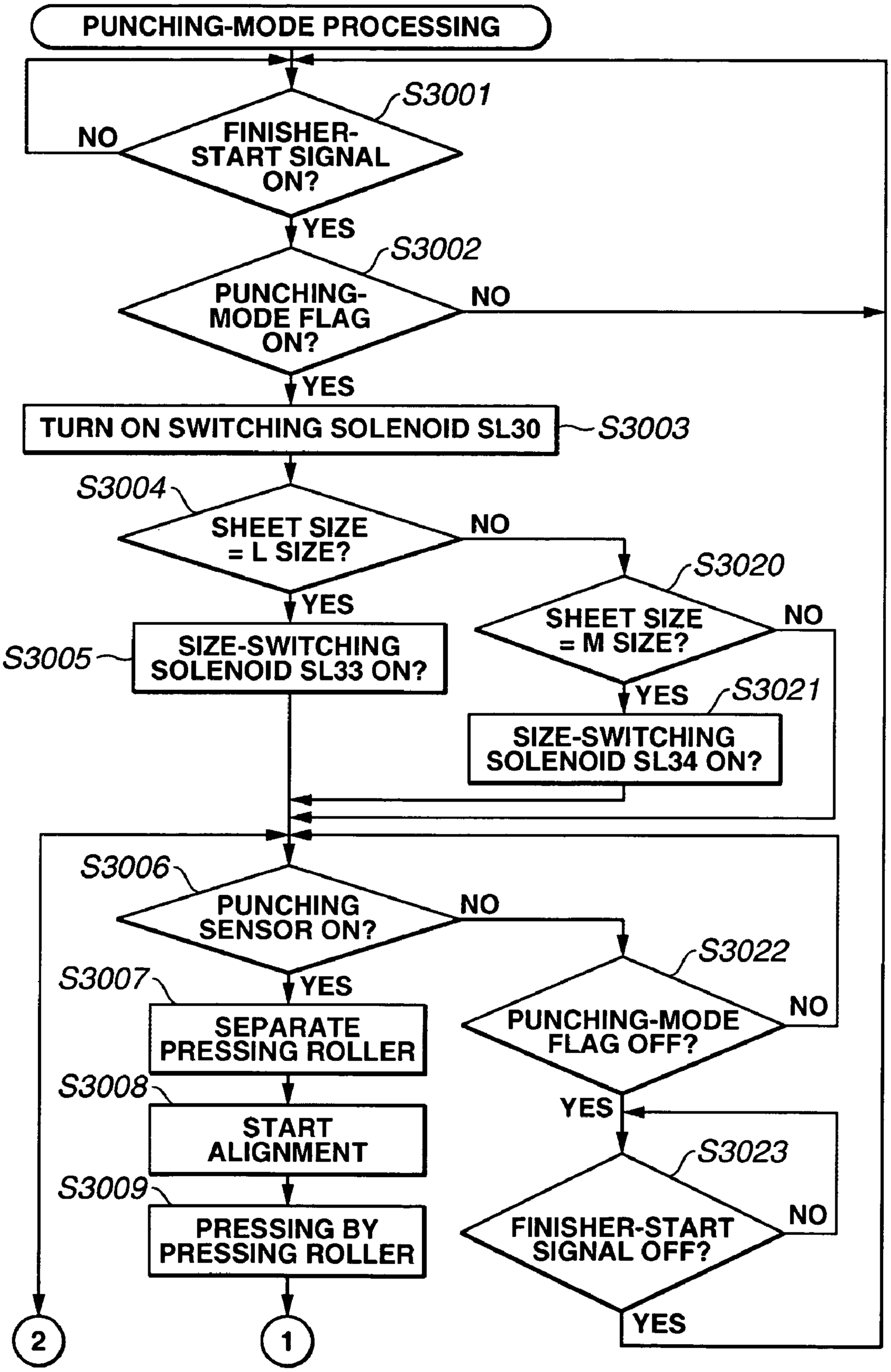
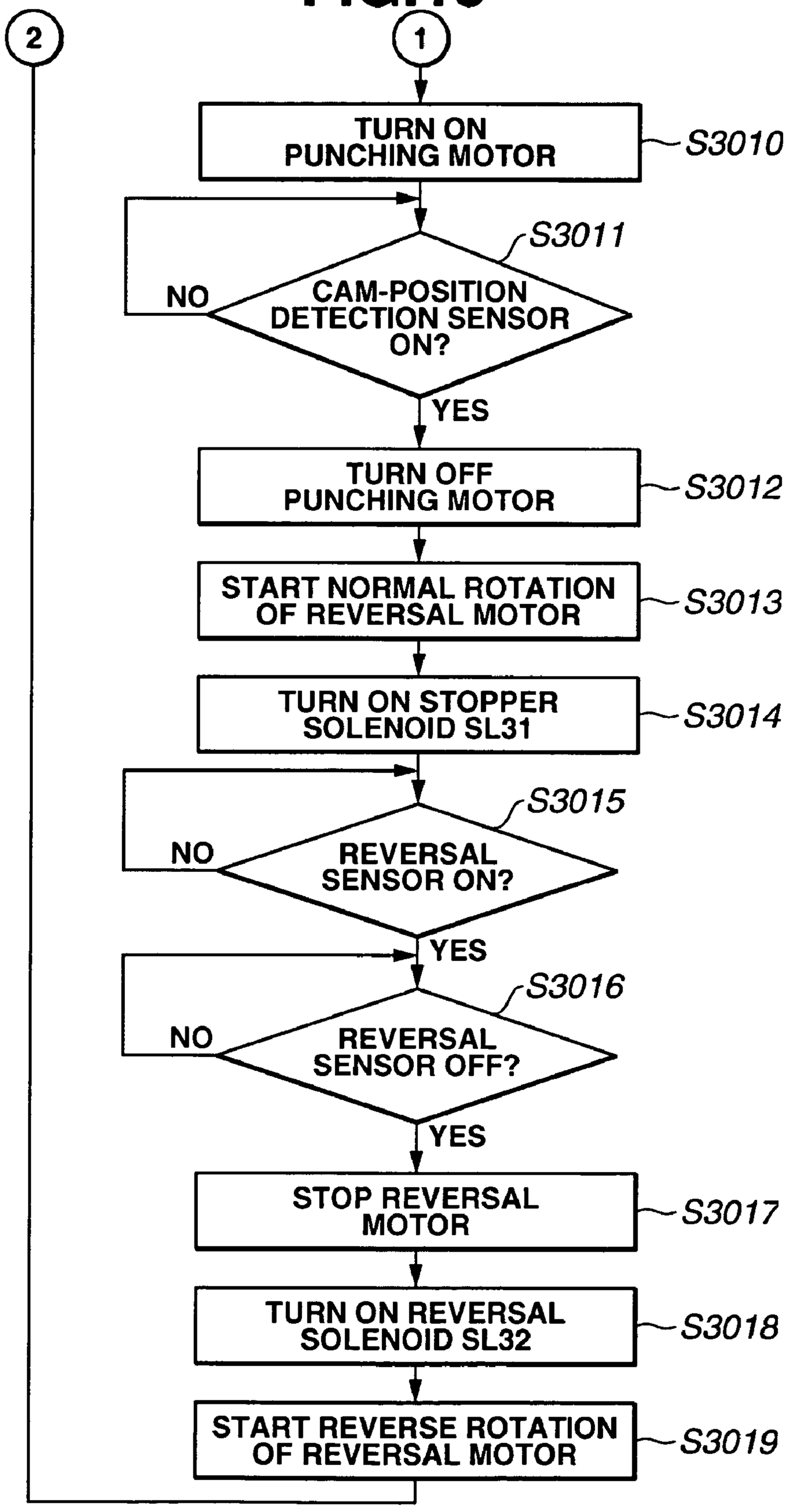

PUNCHING-MODE PROCESSING
S3001
FINISHER-START SIGNAL ON?
NO
YES
S3002
PUNCHING-MODE FLAG ON?
NO
YES
TURN ON SWITCHING SOLENOID SL30
S3003
S3004
SHEET SIZE = L SIZE?
NO
YES
S3020
SHEET SIZE = M SIZE?
NO
YES
S3021
S3005
SIZE-SWITCHING SOLENOID SL33 ON?
SIZE-SWITCHING SOLENOID SL34 ON?
S3006
PUNCHING SENSOR ON?
NO
YES
S3022
PUNCHING-MODE FLAG OFF?
NO
YES
S3007
SEPARATE PRESSING ROLLER
S3008
START ALIGNMENT
S3009
PRESSING BY PRESSING ROLLER
S3023
FINISHER-START SIGNAL OFF?
NO
YES
2
1

FIG.15


2
1
TURN ON PUNCHING MOTOR
S3010
S3011
NO
CAM-POSITION DETECTION SENSOR ON?
YES
TURN OFF PUNCHING MOTOR
S3012
START NORMAL ROTATION OF REVERSAL MOTOR
S3013
TURN ON STOPPER SOLENOID SL31
S3014
S3015
NO
REVERSAL SENSOR ON?
YES
S3016
NO
REVERSAL SENSOR OFF?
YES
STOP REVERSAL MOTOR
S3017
TURN ON REVERSAL SOLENOID SL32
S3018
START REVERSE ROTATION OF REVERSAL MOTOR
S3019

SHEET PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a sheet processing apparatus having a function of performing punching in a sheet.

2. Description of the Related Art

A sheet processing apparatus in which sheets are individually conveyed, and punching is performed in each of the conveyed sheets has been proposed in Japanese Patent Application Laid-Open (Kokai) No. 11-311883 (1999).

In the above-described conventional sheet processing apparatus, however, since conveyed sheets are sequentially punched, position deviation or skew of each sheet with respect to punching means, such as a punch or the like, during a punching operation sometimes causes deviation of a punching position for each sheet. When deviation of a punching position occurs for each sheet, if it is intended to perform binding after performing sheet alignment by superposing a plurality of sheets after punching, the area of punched holes to be used for binding is substantially reduced. As a result, much time is required for a binding operation, or edges are not aligned because a sheet bundle after being bound is oblique with respect to a binder, thereby causing problems in operability and the quality of bound sheets.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a sheet processing apparatus in which the above-described problems are solved, and a method for controlling such an apparatus.

It is another object of the present invention to provide a sheet processing apparatus that can prevent deviation in the position of a hole by efficiently preventing position deviation and skew of a sheet with respect to punching means during a punching operation, and a method for controlling such an apparatus.

According to one aspect of the present invention, a sheet processing apparatus includes a positioning unit arranged to position each of sequentially conveyed sheets at a predetermined position, a punching unit arranged to perform punching for a sheet positioned by the positioning unit, and a discharge unit arranged to discharge a plurality of sheets punched by the punching unit in a superposed state.

According to another aspect of the present invention, an image forming apparatus includes an image forming unit arranged to form an image on a sheet, a positioning unit arranged to position each of sequentially conveyed sheets on which images have been formed by the image forming unit, at a predetermined position, a punching unit arranged to perform punching for the sheet positioned by the positioning unit, and a discharge unit arranged to discharge a plurality of sheets punched by the punching unit in a superposed state.

According to still another aspect of the present invention, a method for controlling a sheet processing apparatus for performing punching in each of sheets includes the steps of positioning each of sequentially conveyed sheets at a predetermined position, performing punching for a sheet positioned in the positioning step, and discharging a plurality of sheets punched in the punching step in a superposed state.

The foregoing and other objects, advantages and features of the present invention will become more apparent from the following detailed description of the preferred embodiment taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view illustrating the internal structure of a copier, serving as an image forming apparatus including a sheet processing apparatus according to a preferred embodiment of the present invention;

FIGS. **2**A and **2**B are diagrams illustrating image forming processing when an original is read in a fixed state and when an original is read while flowing, respectively;

FIG. **3** is a functional block diagram of the copier shown in FIG. **1**;

FIG. **4** is a functional block diagram illustrating the details of an image-signal control unit shown in FIG. **3**;

FIGS. **5**A–**5**D are diagrams illustrating a punching processing unit, a folding processing unit and a finisher unit;

FIG. **6** is a functional block diagram illustrating a finisher control unit for controlling driving of the finisher unit shown in FIG. **5**A;

FIG. **7** is a diagram illustrating a display panel of an operation unit;

FIG. **8** is a cross-sectional view illustrating a punching unit;

FIG. **9** is a cross-sectional view taken along line **9**—**9** shown in FIG. **8**;

FIGS. **10**, **11**, and **12**A and **12**B are diagrams illustrating the flow of a sheet when a sheet from a printer unit is discharged and mounted onto a processing tray;

FIG. **13** is a flowchart illustrating operation-mode determining processing; and

FIGS. **14** and **15** are flowcharts illustrating punching-mode processing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A description will now be provided of a sheet processing apparatus and an image forming apparatus including the same, according to a preferred embodiment of the present invention.

FIG. **1** is a cross-sectional view illustrating the internal structure of a copier **1000**, serving as an image forming apparatus including a sheet processing apparatus, according to the preferred embodiment. The copier **1000** includes an original-feeding unit **100**, an image-reader unit **200**, a printer unit **300**, and a sheet processing unit H, serving as a sheet processing apparatus including a finisher unit **500**, a punching processing unit **550** and the like (to be described later).

As shown in FIG. **1**, an original D is mounted on a feeding tray **1001** of the original-feeding unit **100** in an erect state as seen from the user and in a face-up state (a state in which a surface having an image thereon is placed upward).

Sheets of the original D mounted on the feeding tray **1001** are individually fed to an original-feeding direction (in a direction F) starting from the leading page by the original-feeding unit **100**. A binding position or a punching position of the original D is positioned near a downstream end portion in the feeding direction (hereinafter termed a "leading edge") of the original D. That is, the original D is fed by making the leading-edge side the binding position or the punching position.

Then, the image on the original D is read by conveying the original D from the left toward the right in FIG. **1** on platen glass **102** of the image reader unit **200**, passing through a curved path (a conveying path) within the original feeding unit **100**. The read original D is discharged and mounted onto a discharge tray **112**.

The image reader **200** includes a scanner unit **104** that is disposed below the platen glass **102** so as to be movable substantially parallel with the platen glass **102**, and that can read the original D mounted on the platen glass **102**.

When the original D is conveyed on the platen glass **102** in the above-described manner, the scanner unit **104** remains to stop at a predetermined position. Processing of reading the image on the original D is performed by passage of the original D on the stopped scanner unit **104** (such original-image reading processing will be hereinafter termed "original-flowing reading"). When the original D passes on the platen glass **102**, the original D is illuminated by a lamp **103** of the scanner unit **104**. Reflected light from the original D is guided to an image sensor **109** via mirrors **105**, **106** and **107**, and a lens **108**.

It is also possible to read the image on the original D by temporarily stopping the original D fed by the original-feeding unit **100** on the platen glass **102**, and moving the scanner unit **104** from the left toward the right in FIG. **1** while the original D remains to stop, in order to perform scanning (such original-image reading processing will be hereinafter termed "original-fixing reading").

The original-feeding unit **100** of the copier **1000** is disposed so as to be openable/closable above the platen glass **102** of the image reader unit **200**. When reading the image on the original D without using the original-feeding unit **100**, the user mounts the original D on the platen glass **102** by opening the original-feeding unit **100**. The above-described original-fixing reading is performed for the mounted original D.

Image data of the original D read by the image sensor **109** in the above-described manner is transmitted to an exposure control unit **110** after being subjected to predetermined image processing. The exposure control unit **110** outputs a laser beam corresponding to an image signal. The laser beam is projected onto a photosensitive drum **111** while being scanned by a polygonal mirror **110***a*. An electrostatic latent image corresponding to the scanned laser beam is formed on the photosensitive drum **111**.

The electrostatic latent image formed on the photosensitive drum **111** is visualized as a toner image by being developed by a developing unit **113**.

The printer unit **300** includes cassettes **114** and **115**, a manual insertion unit **125**, and a duplex conveying path **124** as means for supplying a sheet P. The sheet P is supplied to a transfer unit **116** from one of these units. Then, the visualized toner image is transferred onto the sheet P at a transfer unit **116**. The sheet P after image transfer is subjected to fixing processing at a fixing unit **117**.

The sheet P passing through the fixing unit **117** is guided to a path **122** by a flapper **121**. After an upstream end portion in the conveying direction (hereinafter termed a "rear edge") of the sheet P has passed through the flapper **121**, the sheet P is subjected to switchback conveyance, and is conveyed to discharge rollers **118** by the flapper **121** in a state in which the surface of the sheet P is reversed. Then, the sheet P is discharged from the printer unit **300** by the discharge rollers **118**. By performing such processing, the sheet P can be discharged from the printer unit **300** in a face-down state (a state in which the surface of the sheet P having the formed image is placed downward). This processing is termed "reversal discharge".

By discharging the sheet P outside of the apparatus in the face-down state in the above-described manner, when performing image forming processing sequentially from the leading page, i.e., for example, when performing image forming, processing using the original-feeding unit **100**, or

when performing image forming processing for image data from a computer, the sheet P can be discharged and mounted in a state in which the order of pages is correct.

When performing image forming processing by feeding a hard sheet, such as an OHP (overhead projector) sheet or the like, from the manual insertion unit **125**, the sheet is discharged from the printer unit **300** by the discharge rollers **118** in a state in which the surface of the sheet P having a formed toner image is placed upward (a face-up state), without guiding the sheet into the path **122**.

When performing image forming processing for both surfaces of the sheet P, the sheet P subjected to fixing processing at the fixing unit **117** is directly guided toward the discharge rollers **118** by the flapper **121**. Immediately after the rear edge of the sheet P has passed through the flappers **121**, the sheet P is subjected to switchback conveyance, and is guided toward the duplex conveying path **124** by the flapper **121**.

Next, a description will be provided of image forming processing in each of the original-fixing reading and the original-flowing reading with reference to FIGS. **2**A and **2**B, respectively.

As described above, in the original-fixing reading, the image on the original D is read by causing the scanner unit **104** to perform scanning while moving. That is, as shown in FIG. **2**A, reading scanning in which a main scanning direction and a sub-scanning direction are represented by Sy and Sx, respectively, is performed for the image on the original D, in order to read the image of the original D by the image sensor **109**. As for image information (the read image shown in FIG. **2**A) read by the image sensor **109**, image information read in the main scanning direction Sy is sequentially converted into a laser beam by the exposure control unit **110**. By causing the laser beam to perform scanning in the direction of an arrow R by the polygonal mirror **110***a*, an electrostatic latent image is formed on the photosensitive drum **111**.

By visualizing the formed electrostatic latent image as a toner image on the sheet P, an erect image that is not a mirror image (a non-mirror image) is formed on the sheet P as shown in FIG. **2**A.

In the original-flowing reading, as shown in FIG. **2**B, reading scanning, in which a main scanning direction and a sub-scanning direction are represented by Sy and Sx', respectively, is performed for the image on the original D, in order to read the image of the original D by the image sensor **109**. In the original-flowing reading, since the original D is conveyed from the left toward the right in FIG. **1**, the sub-scanning direction Sx' is inverse to the sub-scanning direction Sx in the original-fixing reading. Accordingly, the image read by the image sensor **109** is a mirror image of the image of the original D. Hence, the mirror image must be corrected to an erect image. Accordingly, in the original-flowing reading, mirror-image processing for converting image information read by the image sensor **109** into an erect image is performed. In the mirror-image processing, in order to convert the direction of image data in the main scanning direction Sy into the reverse direction, an image read in one main scanning direction is inverted in the inverse direction.

That is, the mirror-image processing of this embodiment is processing of rotating image information read from the original D by 180 degrees and outputting resultant image information. The processing of rotating an input image by 180 degrees will be hereinafter termed "mirror-image processing".

According to the above-described mirror-image processing, the image read by the image sensor **109** is converted into an erect image (refer to an image after mirror-image processing shown in FIG. **2**B). An electrostatic latent image based on the image after mirror-image processing is formed on the photosensitive drum **111**. The electrostatic latent image formed on the photosensitive drum **111** is visualized as a toner image. By forming the toner image on a sheet, an erect image that is not a mirror image is formed on the sheet.

By performing reversal discharge of the sheet P having the image formed thereon, as shown in FIG. **2**B, the sheet P can be discharged from the printer unit **300** in a state in which the surface of the sheet P having the formed toner image is placed downward (the face-down state). By binding the rear edge of each sheet P thus subjected to reversal discharge using a stapler **601** of the finisher unit **500** (to be described later), the left side of the formed image on each sheet P, as seen from the surface having the image, can be bound.

After passing through the above-described processing, the sheet P having the image formed thereon is discharged from the printer unit **300** by the discharge rollers **118**, and is fed to the punching processing unit **550** within the sheet processing unit H (see FIG. **1**). In the punching processing unit **550**, punching processing of punching two holes, three holes, four holes or the like for file binding can be performed for the sheet P. These holes are punched in a direction of arrangement substantially parallel with the sheet conveying direction or in a direction of arrangement substantially perpendicular to the sheet conveying direction.

In the punching processing unit **550**, if punching processing is performed for the sheet P subjected to the above-described reversal discharge in order to perform punching processing at the leading-edge side of the conveyed sheet P, end portions opposite to the binding position are punched. Accordingly, when performing punching processing, reversal discharge within the printer unit **300** is not performed. The sheet P is fed to the punching processing unit **550** in a state in which the surface of the sheet P having the formed toner image is placed upward (the face-up state). After performing punching processing, the surface of the sheet P is reversed by a reversal unit **561** disposed at a portion downstream from the punching processing unit **550** in the conveying direction. Then, the sheet P whose surface has been reversed is discharged from the punching processing unit **550** in a state in which the surface of the sheet P is placed downward, and is guided to a conveying path **402** toward a folding processing unit **400** after passing through a conveying path **578**.

The sheet P discharged from the punching processing unit **550** or discharged from the printer unit **300** by the discharge rollers **118** without being subjected to punching processing is conveyed to the folding processing unit **400**. In the folding processing unit **400**, processing of folding the sheet P in the shape of Z is performed. For example, folding processing is performed for an A**3**-size or B-**4** size sheet for which assignment of folding processing has been performed through an operation unit **1** (to be described later). In other cases, the sheet P is fed to the finisher unit **500** without being subjected to folding processing.

FIG. **3** is a functional block diagram of the copier **1000**. In FIG. **3**, a CPU (central processing unit) circuit unit **150** includes a CPU (not shown), and controls an original-feeding control unit **101**, an image-reader control unit **201**, an image-signal control unit **202**, a printer control unit **301**, a punching control unit (not shown), a folding-processing control unit **401**, a finisher control unit **501**, and an external I/F (interface) **209**, according to control programs stored in a ROM (read-only memory) **151** and settings on the operation unit **1**. The original-feeding control unit **101**, the image-reader control unit **201**, the printer control unit **301**, the punching control unit, the folding-processing control unit **401** and the finisher control unit **501** control the original-feeding unit **100**, the image-reader unit **200**, the printer unit **300**, the punching processing unit **550**, the folding processing unit **400** and the finisher unit **500**, respectively.

The operation unit **1** includes a plurality of keys for setting various functions relating to image formation, a display panel for displaying a setting state, and the like. The operation unit **1** outputs a key signal corresponding to each type of key operation by the user to the CPU circuit unit **150**, and displays information corresponding to a signal from the CPU circuit unit **150** on the display panel.

A RAM (random access memory) **152** is used as a region for temporarily holding control data, or an operation region for calculation relating to control. The external I/F **209** is an interface between the copier **1000** and an external computer **210**. The external I/F **209** develops print data received from the computer **210** into a bit-map image, and outputs the resultant data to the image-signal control unit **202** as image data. The image-reader control unit **201** transmits image information of the original D read by the image sensor **109** to the image-signal control unit **202**. The printer control unit **301** outputs image data from the image-signal control unit **202** to the exposure control unit **110**.

FIG. **4** is a functional block diagram of the image-signal control unit **202**. The image-signal control unit **202** includes an image processing unit **203**, a line memory **204**, a page memory **205**, and a hard disk **206**. The image processing unit **203** performs correction processing of image information and editing processing in accordance with settings from the operation unit **1**. In the line memory **204**, the above-described mirror-image processing is performed. Image information output from the line memory **204** is input to the printer control unit **301** via the page memory **205**. The hard disk is used for processing of changing the order of pages, i.e., electronic sorting, or the like.

Next, a description will be provided of the configurations of the punching processing unit **550**, the folding processing unit **400** and the finisher unit **500** with reference to FIGS. **5**A–**5**D. FIGS. **5**A–**5**D are diagrams illustrating the configurations of the punching processing unit **550**, the folding processing unit **400** and the finisher unit **500** that have been described with reference to FIG. **1**.

The sheet processing unit H includes a conveying path **555** for guiding the sheet P discharged from the printer unit **300** toward the folding processing unit **400** and the finisher unit **500**. A pair of conveying rollers **556** are provided along the conveying path **555**, and a switching flapper **557** is provided near the conveying rollers **556** at the downstream side. The switching flapper **557** guides the sheet P conveyed by the pair of conveying rollers **556** to one of a punching path **558** toward the punching processing unit and a conveying path **402** toward the folding processing unit **400**.

When performing punching processing, by switching the switching flapper **557** toward the punching path **558**, the sheet P is guided to the punching path **558**. The sheet P guided to the punching path **558** passes through a size-switching flapper unit **568** by a pair of conveying rollers **559**, and the leading edge of the sheet P contacts a punching stopper **563** provided at a downstream portion in the conveying direction of a sheet accommodating path **569**.

The size-switching flapper unit **568** performs a switching operation so that the order of conveyance of the sheet P to

the punching processing unit **550** does not change, and the rear edge of the sheet already conveyed to the punching processing unit **550** does not contact the leading edge of the subsequently conveyed sheet. That is, when conveying a large-size sheet to the punching processing unit **550**, a size-switching flapper **568***a* disposed at the most upstream portion in the conveying direction is rotated in the direction of an arrow A, in order to guide the sheet to the sheet accommodating path **569**. When conveying a small-size sheet to the punching processing unit **550**, if the sheet conveying path is switched to the sheet accommodating path **569** at the position of the size-switching flapper **568***a* as in the case of a large-size sheet, the rear edge of the sheet already conveyed to the punching processing unit **550** sometimes contacts the leading edge of the subsequently conveyed sheet. Accordingly, when conveying a small-size sheet, switching of the conveying path is performed by a size-switching flapper **568***b* disposed at a more downstream side in the conveying direction than the size-switching flapper **568***a*, in order to guide the sheet to the sheet accommodating path **569**. When conveying a further-smaller-size sheet, the sheet is conveyed along the guide shape of the punching path **558** without switching the sheet conveying path by the size-switching flapper unit **568**, and is conveyed to the punching processing unit **550**. The sheets are individually conveyed to the punching processing unit **550**.

In this embodiment, sheets of three sizes can be handled using the two size-switching flappers **568***a* and **568***b*. However, by further increasing the number of size-switching flappers, sheets of a larger number of sizes can be handled.

When the rear edge of a sheet P passes through the pair of conveying rollers **559**, the leading edge of the sheet P contacts the punching stopper **563**, and the entire sheet is accommodated within the sheet accommodating path **569**, one roller **562***a* of a pair of pressing rollers **562** swings to separate from the sheet P (a position indicated by broken lines in FIG. **5**A). The sheet is thereby aligned by an aligning plate (a pair of grasping surfaces) **564**, serving as aligning means, in a state in which the sheet P is hardly influenced by a conveyance resistance due to the pair of pressing rollers **562**, and the like. Sides substantially parallel with the sheet conveying direction (both end portions E in the lateral direction of the sheet) are aligned by being grasped by the aligning plate **564** (i.e., positioned at a predetermined punching position in a direction substantially orthogonal to the sheet conveying direction) (See FIG. **5**D). The leading edge of the sheet P contacts a stopper (contact member) **563**, serving as contact means, by the sheet's own weight, so that the sheet P is correctly positioned at a predetermined punching position in the conveying direction.

The aligning plate **564** has a pair of surfaces disposed substantially parallel to the sheet conveying direction, and at least one of these two grasping surfaces is movable in a direction substantially orthogonal to the sheet conveying direction.

The stopper **563** is disposed so as to be movable between a contact position for performing a positioning operation in a state in which the leading edge of the conveyed sheet contacts and a retracting position where sheet conveyance is not hindered.

The apparatus is controlled so that the above-described sheet positioning operation (aligning operation) by the aligning plate **564** and the stopper **563** is performed for each sheet before a sheet punching operation by the punching unit **560**.

Upon completion of accommodation of the sheet in the sheet accommodating path **569** in the above-described manner, the next sheet discharged from the printer unit **300** is allowed to enter the punching path **558** of the punching processing unit **550**. That is, it is possible to convey the subsequent sheet during processing of aligning/punching the sheet already conveyed into the punching processing unit, and superpose the subsequent sheet in the sheet accommodating path **569** (see FIG. **5**A). Since the sheets can be superposed in the above-described manner, a time allowance for performing processing of aligning/punching the sheets, and the like is provided, so that sheet aligning/punching processing and the like can be performed even if an image forming operation, in which sheets are discharged with a short time interval in a state in which the performance of the printer unit **300** is sufficiently utilized, is performed.

When the number of sheets superposed within the sheet accommodating path **569** is equal to or less than two, a confluent portion of sheets can always be at the position of X shown in FIG. **5**B by using the above-described size-switching flappers. That is, in the case of a large-size sheet, an odd-numbered sheet is guided into the sheet accommodating path **569** positioned at the left side in FIG. **5**A after passing through a path **574**, by rotating the size-switching flapper **568***a* to a position shown in FIG. **5**A (in the direction of A). An even-numbered sheet is fixed at a position shown in FIG. **5**B without rotating the size-switching flapper **568***a*, and is guided into the sheet accommodating path **569** directly from the punching path **558**. It is thereby possible to shorten a time of superposition of sheets, and provide a time for processing to be performed in a state in which the sheets are free (for example, aligning processing).

Upon completion of sheet aligning processing in the above-described manner, the one roller **562***a* of the pair of pressing rollers **562** again returns to a position indicated by solid lines in FIG. **5**A to grasp the sheet, and conveys the sheet at a conveying speed larger than the speed before the aligning processing. At that time, since the stopper **563** protrudes in the conveying path, the leading edge of the sheet can be aligned by assuredly contacting the stopper unit in the aligning processing even if the leading edge of the sheet separates from the stopper **563**.

The punching unit (punching means) **560** is, for example, a punching device described in Japanese Patent Application Laid-Open No. 2001-129792, that sequentially performs a punching operation for each of sheets individually conveyed to a predetermined punching position within a conveying path. The stopper **563** is disposed at a portion downstream from the punching unit **560** in the conveying path.

As shown in FIGS. **8** and **9**, the punching unit **560** includes a reciprocatable cam member **581** where a cam is formed, a punch **582** engaging with the cam of the cam member **581** and capable of performing reciprocating movement in a direction "a" orthogonal to the moving direction of the cam member **581** in accordance with reciprocating movement of the cam member **581**, a die **583** having a die hole where the punch **581** is to enter formed therein, a cam-member driving motor M**30** (hereinafter termed a "punching motor") for reciprocating the cam member **581**, and a cam-member-position detection sensor **585** for stopping the punching motor M**30** by detecting the moved position of the cam member **581**, and can perform high-speed punching processing for the sheet in a state in which the leading edge of the sheet assuredly contacts the punching stopper **563**.

When the sheet is not separated from the punching stopper **563** after aligning processing in a configuration in which the sheet accommodating path **569** is substantially vertical as shown in this embodiment, punching processing

may be performed by the punching unit **560** immediately after alignment, and thereafter sheet conveyance may be started by the pair of pressing rollers **562**.

By adopting a configuration in which a mounting stopper operating in the same manner as the above-described punching stopper **563** is provided near the punching unit **560** at the upstream side in the sheet conveying path, and a mechanism for individually separating sheets mounted on the mounting stopper is provided, it is possible to accommodate at least three sheets in the sheet accommodating path **569**, and perform stable punching processing for sheets conveyed at a higher speed and with a smaller interval between the sheets.

When punching processing has been performed for a sheet, the punching stopper **563** retracts from the conveying path, and the sheet is fed to a reversal unit **561** by the pair of pressing rollers **562**. When the rear edge of the sheet passes through the punching stopper **563**, the punching stopper **563** again protrudes into the conveying path, to contact the leading edge of the subsequently fed sheet. The conveying speed of the subsequent sheet is larger that the speed before aligning processing (for example, about twice the speed before alignment), so that the leading edge of the subsequent sheet does not reach the punching stopper **563** before the rear edge of the sheet passes through the punching stopper **563**.

In the reversal unit **561**, the sheet is drawn into a reversal path **566** by a pair of reversal rollers **565**, and the pair of reversal rollers **565** perform reverse rotation when the rear edge of the sheet passes through a reversal flapper **567**. At that time, the direction of the reversal flapper **567** is switched, and the sheet is guided to a conveying path **578**. The sheet guided to the conveying path **578** is fed to a conveying path **402** by respective pairs of conveying rollers **571** and **572**.

A description of the folding unit **400** and the finisher unit **500** will be omitted.

Next, a description will be provided of the configuration of the finisher control unit **501** for controlling driving of the finisher unit **500**, with reference to FIG. **6**. FIG. **6** is a functional block diagram illustrating the configuration of the finisher control unit **501** shown in FIG. **3**.

As shown in FIG. **6**, the finisher control unit **501** includes a CPU circuit unit **910** including a CPU **911**, a ROM **912**, a RAM **913** and the like. The CPU circuit unit **910** performs data exchange by communicating with the CPU circuit unit **150** provided at the main body of the copier via a communication IC (integrated circuit) **914**, and controls driving of the finisher unit **500** by executing various programs stored in the ROM **912** based on instructions from the CPU circuit unit **150**. The CPU circuit unit **910** also includes a jam timer (not shown) for detecting a jam.

When controlling driving of the finisher unit **500**, detection signals from various sensors are input to the CPU circuit unit **150**. The various sensors include an entrance sensor **521** and a discharge sensor **533** (see FIG. **5**A).

A driver **920** is connected to the CPU circuit unit **910**. The driver **920** drives various motors and solenoids, and the like, based on signals from the CPU circuit unit **910**.

The various motors include an entrance motor M**1**, serving as a driving source for a pair of conveying rollers **503**, a buffer motor M**2**, serving as a driving source for a buffer roller **505**, a discharge motor M**3**, serving as a driving source for a pair of conveying rollers **506**, a pair of discharge rollers **507**, and a pair of discharge rollers **509**, a bundle discharge motor M**4**, serving as a driving source for discharge rollers **680***a* and **680***b*, and a punching conveyance motor M**31** for driving respective pairs of conveying rollers **556** and **559** for conveying a sheet to the punching unit **560**, an alignment motor M**34** for aligning a sheet whose leading edge has reached the punching stopper **563** at a position adjusted to the punching unit **560** in a direction substantially orthogonal to the sheet conveying direction, a punching pressing motor M**35** for driving the pressing rollers **562** for pressing the sheet against the punching stopper **563**, a punching motor M**30** for reciprocating the cam member **581** for reciprocating the punch **582** within the punching unit **560**, a reversal motor M**33** for driving the pair of reversal rollers **565** for drawing the sheet into the reversal path **566** and feed the sheet in a switchback state, and a reversal conveyance motor M**32** for driving conveying rollers **573** for conveying the sheet into the reversal path **566** and further feed the reversed sheet to the conveying path **578**.

Each of the above-described motors can rotate a roller driven by the motor at a constant speed, or rotate the corresponding roller at a particular speed. Each of the motors can be driven in any one of normal and reverse directions of revolution by the driver **920**.

The solenoids include a switching solenoid SL**1** for switching a switching flapper **510**, a switching solenoid SL**2** for switching a switching flapper **511**, a switching solenoid SL**30** for switching a switching flapper **557**, size-switching solenoids SL **33** and SL**34** for switching a path in accordance with the length of the sheet entering the sheet accommodating path **569**, a stopper solenoid SL**31** for protruding the punching stopper **563** into the conveying path or retracting the punching stopper **563** from the inside of the conveying path, a reversal solenoid SL**32** for driving the reversal flapper **567** for switching the conveying path, and a roller pickup solenoid SL**35** for causing the one roller **562***a* of the pair of pressing rollers **562** to pick up the sheet.

Next, a method for setting an operation mode will be described with reference to FIG. **7**. FIG. **7** illustrates a picture frame displayed on the display panel of the operation unit **1** of the copier **1000**. This picture frame operates as a touch-panel. By touching the inside of a frame surrounding a displayed function, the function is executed.

In the picture frame shown in FIG. **7**, the user can select one of operation modes, such as a non-sorting mode, a sorting mode, a stapling sorting mode (binding mode), a punching mode, a Z folding mode and the like.

As described above, in the original-flowing reading, mirror-image processing (i.e., processing of rotating an input image by 180 degrees) is performed for read image information so that an erect image is formed on a sheet. An image is formed on the sheet based on the image information subjected to mirror-image processing. The surface of the sheet is reversed within the printer unit **300** or the punching processing unit **550** and is subjected to reversal discharge. Hence, when the sheet P having the formed image is received into the finisher unit **500**, the surface having the formed image is placed downward (the face-down state). Accordingly, as shown in FIGS. **10**–**12**B, a sheet P**1** and a sheet P**2** conveyed from the printer unit **300** are conveyed to the finisher unit **500** in a state in which the surface of the sheet having the formed image is placed downward.

The sheet P**1** fed to the finisher unit **500** is conveyed to the buffer roller **505** via a finisher path **552**, and is guided to a sorting path **522**. At that time, following the sheet P**1**, conveyance of the sheet P**2** from the printer unit **300** into the finisher unit **500** is started.

Then, as shown in FIG. **11**, the sheet P**1** is discharged and mounted onto a processing tray **630** in a state in which the surface of the sheet having the formed image is placed

downward, and in a state in which the binding position faces a stapler **601**. The sheet P**2** succeeding the sheet P**1** is guided to the main body of the finisher unit **500** and is conveyed to the buffer roller **505**. Thus, the sheet P**1** and the sheet P**2** are sequentially discharged and mounted onto the processing tray **630**.

As shown in FIG. **12**A, the sheet P**2** succeeding the sheet P**1** is accommodated in a state of being superposed on the sheet P**1**. The images formed on the sheet P**1** and the sheet P**2** have been subjected to mirror-image processing so as to provide erect images. When a sheet is conveyed from the printer unit **300** to the finisher unit **500**, the surface of the sheet can be reversed at the printer unit **300** or within the punching processing unit **550**. Accordingly, the sheet P**1** and the sheet P**2** are mounted onto the processing tray **630** in a state in which the surface having the formed image is placed downward (the face-down state), and in a state in which the punched positions and the binding positions face the stapler **601**.

When performing binding processing for a sheet bundle including such a plurality of sheets, binding processing is performed by the stapler **601** when the sheet P**2** has been discharged and mounted onto the processing tray **630**. FIG. **12**B illustrates a sheet bundle including the sheet P**1** and the sheet P**2** subjected to binding processing by the stapler **601**.

As described above, in this embodiment, processing of rotating an input image by 180 degrees (termed "mirror-image processing" in this embodiment), the image subjected to mirror-image processing is formed on a sheet, and the sheet having the formed image is mounted onto the processing tray **630**.

Although in this embodiment, the case in which the image of the original D is input from the image-reader unit **200** has been described, it is also possible to apply the present invention to a case in which image information is input from the external computer **210**, and to form an image on the sheet P by performing the same processing (see FIG. **3**). Rotation processing (termed "mirror-image processing" in this embodiment) is performed for the input image whenever necessary, an image is formed on the sheet P based on image information subjected to mirror-image processing, and the sheet P having the formed image is discharged to the finisher unit **500** by reversing the surface of the sheet P. As a result, leading-page processing and post-processing can be compatible. When performing post-processing, comprising stapling processing and the like, for a sheet bundle including a plurality of sheets discharged and mounted onto the processing tray **630**, the direction and the binding position of the image on each of the sheets can coincide.

Next, processing relating to control of driving of the finisher unit **500** will be described.

FIG. **13** is a flowchart illustrating processing for determining an operation mode for the finisher unit **500**. This processing is executed by the CPU circuit unit **910** within the finisher control unit **501** based on instructions from the CPU circuit unit **150**.

First, it is determined whether or not a finisher-start signal for instructing start of an operation for the finisher unit **500** has been input to the finisher control unit **501** (step S**2301**). The processing of step S**2301** is repeated until a start key for instructing start of a copying operation is depressed on the operation unit **1** by the user, and a finisher-start signal is input from the CPU circuit unit **150** to the finisher control unit **501**.

If the result of the determination in step S**2301** is affirmative, driving of the entrance motor Ml is started (step S**2302**).

Then, a supply signal is output to the CPU circuit unit **150** of the copier **1000** via the communication IC **914** (step S**2305**). The CPU circuit unit **150** that has received this supply signal starts image forming processing.

Then, in a post-processing selection menu picture frame shown in FIG. **7**, it is determined whether or not a punching mode has been set by the user (step S**2313**). If the result of the determination in step S**2313** is affirmative, a punching-mode flag is turned on (step S**2314**), and the process proceeds to step S**2308**. If the result of the determination in step S**2313** is negative, the process proceeds to step S**2308**.

In step S**2308**, it is determined which one of a non-sorting mode, a sorting mode and a stapling sorting mode corresponds to the set operation mode. If it is determined in step S**2308** that the set operation mode is the non-sorting mode, non-sorting processing is performed (step S**2309**).

If it is determined in step S**2308** that the set operation mode is the sorting mode, sorting processing is performed (step S**2310**).

If it is determined in step S**2308** that the set operation mode is the stapling sorting mode, stapling sorting processing is performed (step S**2311**).

When the non-sorting processing has been completed in step S**2309**, when the sorting processing has been completed in step S**2310**, or when the stapling sorting processing has been completed in step S**2311**, driving of the entrance motor M**1** is stopped. When the punching-mode flag has been turned on in step S**2314**, the punching-mode flag is turned off (step S**2312**). Then, the process returns to step S**2301**, and input of a finisher-start signal is awaited.

As described above, the sheet can be guided to the processing tray **630** by performing switching by rotating the switching flappers **510** and **511**, and aligning processing for a bundle of sheets discharged and mounted on the processing tray **630** can be performed. It is also possible to perform binding processing in which a sheet bundle mounted on the processing tray **630** is bound, using the stapler **601**.

Next, punching-mode processing will be described with reference to the flowcharts shown in FIGS. **14** and **15**. This processing is executed by the CPU circuit unit **910** within the finisher control unit **501** based on instructions from the CPU circuit unit **150** of the main body, while always performing monitoring.

First, an instruction to start an operation for the finisher unit **500** is input from the CPU circuit unit **150** to the CPU circuit unit **910** within the finisher control unit **501**, and it is determined whether or not a finisher-start signal is in an on-state (step S**3001**). The processing of step S**3001** is repeated until a finisher-start signal is turned on.

If the result of the determination in step S**3001** is affirmative, then, it is determined whether or not a punching-mode flag has been turned on in the above-described processing of step S**2314** shown in FIG. **13** (step S**3002**). If the result of the determination in step S**3002** is negative, the process returns to step S**3001**. If the result of the determination in step S**3002** is affirmative, the switching solenoid SL**30** is turned on (step S**3003**), and the sheet is guided to the punching path **558** by the switching flapper **557**. The sheet guided to the punching path **558** reaches the size-switching flapper **568** via the pair of conveying rollers **559**. The sheet sizes are classified in advance in three types. These sizes are represented by an L (large) size, an M (medium) size and an S (small) size. When the sheet size is the L size, the size-switching solenoid SL**33** is turned on (step S**3005**), and the size-switching flapper **568***b* rotates in the direction of the arrow A shown in FIG. **5**A, to switch the path to an L path **574** (see FIG. **5**C). When the sheet size is

the M size, the size-switching solenoid SL**34** is turned while the size-switching solenoid SL**33** remains in an off-state, and the path is switched to an M path **575** by the size-switching flapper **568***b* (step S**3021**). When the sheet size is the S size, the size-switching solenoids SL**33** and SL**34** are not turned on. The sheet passes through an S path **576**, is conveyed along the sheet accommodating path **569** by the pair of pressing rollers **562**, and the leading edge of the sheet reaches the punching stopper **563**.

The number of each of the size-switching flappers and the size-switching solenoids is not limited to two as in this embodiment. By further increasing the number of size-switching flappers, sheets of a larger number of sizes can be handled.

By adopting a configuration in which a punching stopper unit obtained by integrating the punching stopper **563**, the punching unit **560** and a punching sensor **570** is movable in the sheet conveying direction, without using size-switching flappers and size-switching solenoids, and moving the punching stopper unit to a position corresponding to the size of sheets to be subjected to punching processing, the rear edge of a sheet already contacting the punching stopper **563** and the leading edge of the subsequently conveyed sheet may be superposed without contacting.

Then, it is determined whether or not the punching sensor **570** is in an on-state (step S**3006**). If the result of the determination in step S**3006** is affirmative, it indicates that the sheet has reached the punching unit **560**. Accordingly, the roller pickup solenoid SL**35** is turned on, and the one roller **562***a* of the pair of pressing rollers **562** separates from the sheet (step S**3007**). An aligning operation by the aligning plate **564** driven by the aligning motor M**34** is performed for the sheet in a state in which the sheet can freely move without being hindered by the pressing roller and the like as described above (step S**3008**). Upon completion of the sheet aligning operation, the roller-pickup solenoid SL**35** is turned off, and the one roller **562***a* of the pair of pressing rollers **562** is again brought in pressure contact with the sheet (step S**3009**), to start sheet conveyance. When a loop starts to be formed after the lapse of a predetermined time after the sheet has been further strongly pressed against the punching stopper **563**, the punching motor M**30** is driven (step S**3010** shown in FIG. **18**), to move the cam member **581**. After the cam member **581** has moved by a predetermined amount and the punch **582** has performed punching processing for the sheet, the cam member **581** is detected by a cam-member-position detection sensor **585** (step S**3011**), and driving of the punching motor M**30** is stopped (step S**3012**). After the punching motor M**30** has stopped, the reversal motor M**33** starts normal rotation, to prepare to draw the sheet into the reversal path **566** (step S**3013**). Then, the stopper solenoid SL**31** is turned on (step S**3014**), the punching stopper **563** retracts from the conveying path, and the sheet is conveyed to the conveying rollers **573** by the pair of pressing rollers **562**. Then, the sheet is conveyed into the reversal path **566** by the conveying rollers **573** and the pair of reversal rollers **565**. At that time, the conveying speed by the conveying rollers **573** and the pair of reversal rollers **565** is larger than the conveying speed of the pair of conveying rollers **559**, so that the sheet can be drawn from the sheet accommodating path **569** at a high speed.

The amount of sheet conveyance by the pair of pressing rollers **562** can be measured by an encoder (not shown). By measuring the amount of sheet conveyance by the encoder, the stopper solenoid SL**31** is turned off when the rear edge of the sheet passes through the punching stopper **563**, to again protrude the punching stopper **563** into the conveying path.

When the reversal sensor **577** has detected the sheet (step S**3015**), and the rear edge of the sheet has been detected by passage of the sheet through the reversal sensor **577** (step S**3016**), the pair of reversal rollers **565** temporarily stops by stopping the reversal motor M**33** (step S**3017**). Then, the reversal solenoid SL**32** is turned on (step S**3018**), and the path is switched by the reversal flapper **567**. Thereafter, by reverse revolution of the reversal motor M**33**, the pair of reversal rollers **565** starts reverse rotation (step S**3019**), and the sheet is conveyed from the conveying path **578** to the conveying path **402** via the respective pairs of conveying rollers **571** and **572**. Then, the process returns to step S**3006** shown in FIG. **17**.

If the result of the determination in step S**3006** is negative, it is determined whether or not a punching-mode flag is in an off-state (step S**3022**). If the result of the determination in step S**3022** is negative, the process returns to step S**3006**. If the result of the determination in step S**3022** is affirmative, it is awaited that the finisher-start signal is turned off (step S**3023**). When the finisher-start signal has been turned off, the process returns to step S**3001**.

As described above, it is possible to realize an image forming apparatus, including a sheet processing apparatus and a printer unit (image forming unit) for forming an image on a sheet, that performs punching processing for the sheet on which the image has been formed by the image forming unit, by the sheet processing unit.

The CPU circuit unit can cause one of the aligning plate and the stopper to perform a positioning operation before a punching operation by the punching unit. A positioning operation by the aligning plate and a positioning operation by the stopper can, of course, also be simultaneously performed. In another approach, it is also possible to cause one of the aligning plate and the stopper to perform a positioning operation after causing the other one to perform a positioning operation.

The punching unit punches at least two arranged holes in a sheet. The CPU circuit unit can cause one of the aligning plate and the stopper to perform a positioning operation after causing the other one to perform a positioning operation, based on the relationship between the sheet conveying direction and the direction of arrangement of the at least two holes in the sheet. More specifically, it is possible to provide a configuration in which, when the sheet conveying direction is substantially orthogonal to the direction of arrangement of the holes, a positioning operation by the aligning plate is performed before a positioning operation by the stopper, and when the sheet conveying direction is substantially parallel with the direction of arrangement of the holes, a positioning operation by the stopper is performed before a positioning operation by the aligning plate.

Although the CPU circuit unit can cause the aligning plate and the stopper to perform respective positioning operations simultaneously, the CPU circuit unit may cause one of the aligning plate and the stopper to perform a positioning operation after causing the other one to perform a positioning operation.

More specifically, a configuration may be adopted in which the punching unit punches at least two arranged holes in a sheet, and the CPU circuit unit causes one of the aligning plate and the stopper to perform a positioning operation after causing the other one to perform a position-

ing operation, based on the relationship between the sheet conveying direction and the direction of arrangement of the holes.

That is, it is desirable to adopt a configuration in which, when the sheet conveying direction is substantially orthogonal to the direction of arrangement of the holes, the CPU circuit unit causes the aligning plate to perform a positioning operation before a positioning operation by the stopper. According to this configuration, since positioning of a sheet with respect to predetermined punching positions in the conveying direction that tends to influence the punching positions is performed later, punching processing having high position accuracy can be performed for the sheet.

On the other hand, it is desirable to adopt a configuration in which, when the sheet conveying direction is substantially parallel to the direction of arrangement of the holes, the CPU circuit unit causes the stopper to perform a positioning operation before a positioning operation by the aligning plate. According to this configuration, since positioning of a sheet with respect to predetermined punching positions in a direction substantially orthogonal to the conveying direction that tends to influence the punching positions is performed later, punching processing having high position accuracy can be performed for the sheet.

The individual components shown in outline or designated by blocks in the drawings are all well known in the sheet processing apparatus arts and their specific construction and operation are not critical to the operation or the best mode for carrying out the invention.

While the present invention has been described with respect to what is presently considered to be the preferred embodiment, it is to be understood that the invention is not limited to the disclosed embodiment. To the contrary, the present invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

What is claimed is:

1. A method for controlling a sheet processing apparatus said sheet processing apparatus including:

a positioning unit arranged to position each of sequentially conveyed sheets at a predetermined position, wherein said positioning unit positions a sheet at a predetermined punching position in a direction substantially orthogonal to a conveying direction of the sheet, by grasping both end portions of the sheet in a lateral direction;

an accommodating unit disposed at a portion upstream of said positioning unit and arranged to accommodate the sheet to be conveyed to said positioning unit;

a punching unit arranged to perform punching one-by-one for a sheet positioned by said positioning unit; and

a discharge unit arranged to discharge a sheet punched by said punching unit, said method for controlling the sheet processing apparatus comprising:

a first controlling step of making said positioning unit operate to position one-by-one the sheet prior to a punching operation by said punching unit; and

a second controlling step of making said accommodating unit accommodate subsequently conveyed sheets during the positioning operation or the punching operation.

2. An apparatus according to claim **1**, wherein said accommodating unit is able to accommodate a plurality of sheets.

3. An apparatus according to claim **1**, wherein said accommodating unit shifts the position to accommodate the sheets depending on the size of conveyed sheets.

4. A sheet processing apparatus comprising:

a positioning unit arranged to position each of sequentially conveyed sheets at a predetermined position, wherein said positioning unit positions a sheet at a predetermined punching position in a direction substantially orthogonal to a conveying direction of the sheet, by grasping both end portions of the sheet in a lateral direction;

an accommodating unit disposed at a portion upstream of said positioning unit and arranged to accommodate a sheet to be conveyed to said positioning unit;

a punching unit arranged to perform punching one-by-one for a sheet positioned by said positioning unit;

a discharge unit arranged to discharge a sheet punched by said punching unit; and

a controlling unit arranged to make said positioning unit operate to position one-by-one the sheet prior to a punching operation by said punching unit and to make said accommodating unit accommodate subsequently conveyed sheets during the positioning operation or the punching operation.

5. An apparatus according to claim **1**, wherein said positioning unit comprises a pair of grasping planes disposed substantially parallel to the conveying direction of the sheet, and wherein at least one of said grasping planes is movable in a direction substantially orthogonal to the conveying direction.

6. An apparatus according to claim **1**, further comprises a stopper arranged to position the sheet at a predetermined punching position in the conveying direction of the sheet by contacting a leading edge of the conveyed sheet.

7. An apparatus according to claim **6**, wherein said stopper is disposed at a portion downstream from said punching unit in a conveying path.

8. An apparatus according to claim **6**, wherein said stopper comprises a contact member disposed so as to be movable between a contact position for performing the contact operation by contacting the leading edge of the conveyed sheet and a retracting position where conveyance of the sheet is not hindered.

9. An apparatus according to claim **6**, wherein said punching unit punches at least two arranged holes in the sheet, and wherein, after performing a positioning operation according to one of positioning by grasping the sheet in the lateral direction and positioning by said stopper, said positioning unit performs a positioning operation according to the other positioning, based on a relationship between the conveying direction of the sheet and a direction of arrangement of the holes.

10. An apparatus according to **9**, wherein said positioning unit performs the positioning operation by grasping the sheet in the lateral direction before the positioning operation by the stopper, when the conveying direction of the sheet is substantially orthogonal to the direction of arrangement of the holes.

11. An apparatus according to claim **9**, wherein said positioning unit performs the positioning operation by the stopper before the positioning operation by grasping the sheet in the lateral direction, when the conveying direction of the sheet is substantially parallel to the direction of arrangement of the holes.

12. An image forming apparatus comprising:

an image forming unit arranged to form an image on a sheet;

a positioning unit arranged to position each of sequentially conveyed sheets on which images have been formed by said image forming unit, at a predetermined position, wherein said positioning unit positions a sheet at a predetermined punching position in a direction substantially orthogonal to a conveying direction of the sheet, by grasping both end portions of the sheet in a lateral direction;

an accommodating unit disposed at a portion upstream of said positioning unit and arranged to accommodate a sheet conveyed from said image forming unit and to be conveyed to said positioning unit;

a punching unit arranged to perform punching one-by-one for a sheet positioned by said positioning unit;

a discharge unit arranged to discharge a sheet punched by said punching unit; and

a controlling unit arranged to make said positioning unit operate to position one-by-one the sheet prior to a punching operation by said punching unit and to make said accommodating unit accommodate subsequently conveyed sheets during the positioning operation and/or the punching operation.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,134,370 B2
APPLICATION NO. : 10/691541
DATED : November 14, 2006
INVENTOR(S) : Mitsushige Murata et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

ON THE TITLE PAGE:
At Item (74), Attorney, "Fitapatrick," should read --Fitzpatrick,--

COLUMN 9:
Line 21, "larger that" should read --larger than--.

COLUMN 10:
Line 26, "SL 33" should read --SL33--.

COLUMN 15:
Line 41, "apparatus" should read --apparatus,--.

COLUMN 16:
Line 26, "claim 1," should read --claim 4,--.

Signed and Sealed this

Twenty-fifth Day of December, 2007

JON W. DUDAS
Director of the United States Patent and Trademark Office